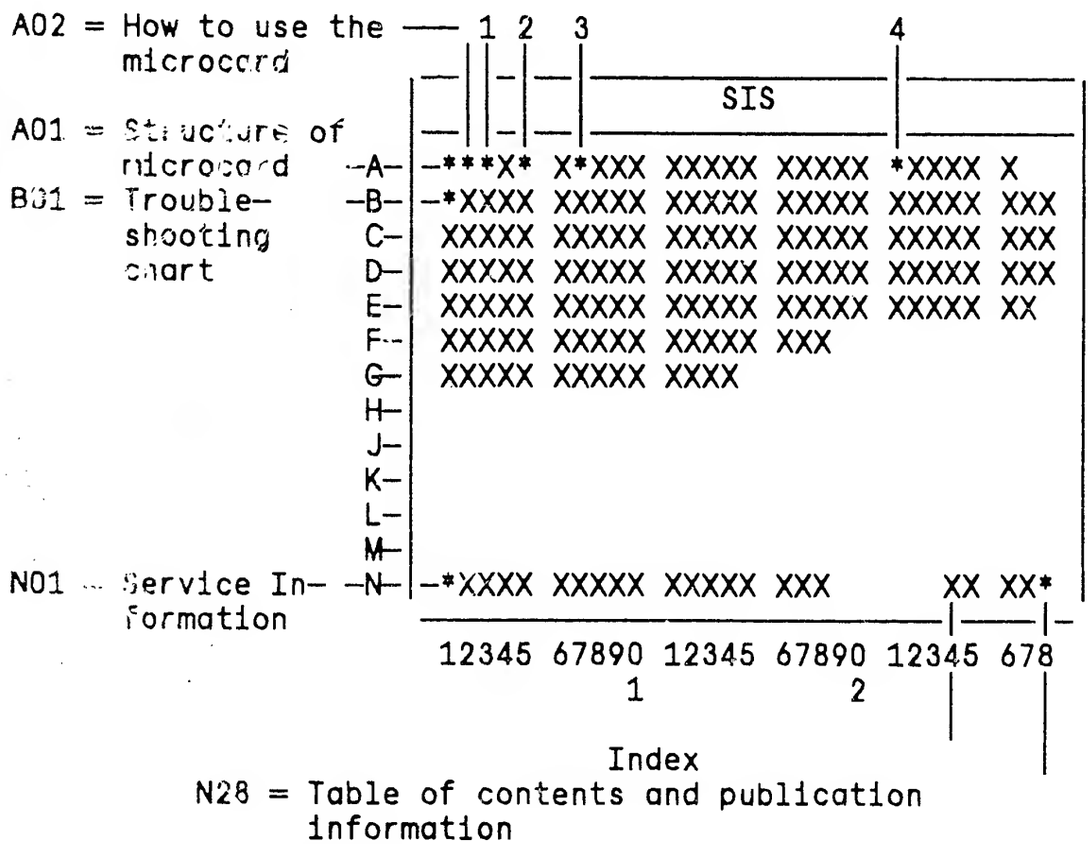
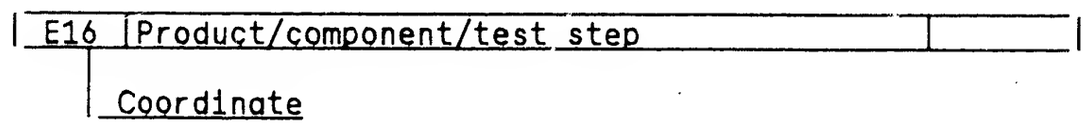
STRUCTURE OF THE MICROCARD (BASIC INSTRUCTIONS)




a. Read from left to right.

b. Title of micropicture (appears on each coordinate).




c. Limits of section




SPECIAL FEATURES:

These instructions contain the testing and repair of ABS in the vehicle

* , CITROEN CX 25 GTi Turbo as of March 1985.

The ABS contains 4 wheel-speeed sensors and 3 hydraulic channels with split brake circuits for front and rear axles.

The hydraulic modulator consists only of one ABS valve block without return pump and motor relay.
The brake system is supplied from the central hydraulic system. It contains a central hydraulic pump with safety valve and brake-valve block. This makes it possible to dispense with the return pump. The oil coming from the wheel-brake cylinders during pressure reduction is returned to the oil-supply reservoir via an additional connection on the hydraulic modulator.

C A U T I O N :

Do not use brake fluid (e.g. DOT 4), but only the specified mineral oil LHM (which is colored green).

TEST SPECIFICATIONS

For safety reasons, the ABS must be tested only with the ABS tester. The rapid diagnosis chart contains all important test specifications as well as notes on testing and trouble-shooting.

TEST CONDITIONS FOR TESTING WITH ABS 2 LED TESTER

* Correct size of tire mounted?

* Check ground connection of overvoltage-protection relay term.3 for security and corrosion.

* Check hydraulic connections and joints on hydraulic modulator for leaks (visual examination, arrows).

* If during driving the ABS warning lamp comes on occasionally (e.g. after switching on electrical devices) and goes out again by itself, check battery and power supply (alternator, regulator and voltage drops)

* If the ABS warning lamp is continuously lit and does not go out, check the following points:

  - Is multiple plug correctly seated on controller and has it latched in?

  - All plug-in contacts O.K.?

  - Spring contacts latched in?

  - Check installation position of seal ring in controller plug for correct seating: round section to bottom.



  - Check wheel-speed sensor leads at controller plug for correct assignment:

    Wheel-speed sensors:
    Front left - term. 5 and term. 4.
    Front right - term. 11 and term. 21.
    Rear left - term. 8 and term. 9.
    Rear right - term. 24 and term. 26.

  - V-belt torn?
    (Alternator does not supply voltage, charging and ABS warning lamp light up).

* Connect ABS --LED tester to ABS wiring harness.

  - Only detach and connect controller with ignition off.

  - For test purposes, switch on ignition in all program switch settings (tester runs on power supplied by vehicle battery).

  - Observe LED (green) for power supply in all program switch settings.

I M P O R T A N T!

Do not drive with the tester connected!
The entire test program is to be repeated whenever repairs have been carried out.
The ABS system is a vehicle safety system.
Work on this system require detailed knowledge of the system.
The conventional brake system must be working properly.

General trouble-shooting information:

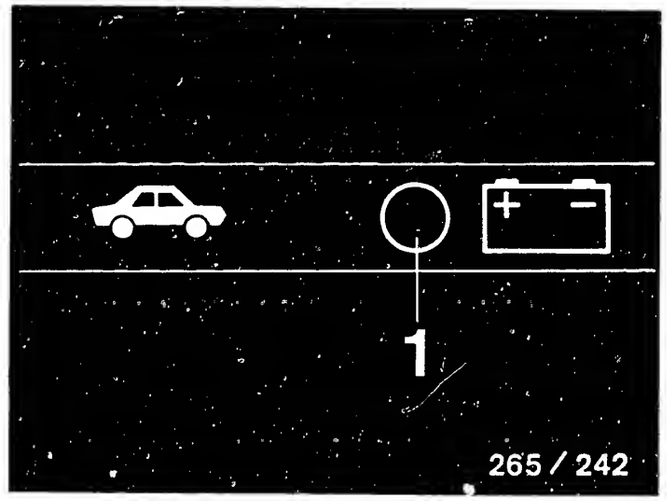
Check all leads for short-circuit to ground and contact with positive leads, as well as for rubbing and pinching.

Rapid diagnosis chart

Do not run with tester connected! Are all test requirements complied with?

Program-selector-switch position 1 to 6

| Test on (measurement at terminals) | Additional operation | Test specification (reading) | Possible causes of trouble (see coordinates) |
|---|---|---|---|
| Power supply<br><br>(term. 20 and term. 1) | Ignition on | LED 1 (Upper illustration) Lights up continuously | *Fuse defective (C15)<br>*Battery insufficiently charged<br>*Voltage drops too high (C17)<br>*Over-voltage protection relay defective (C17)<br>*Check lead to driving switch term. 15 |



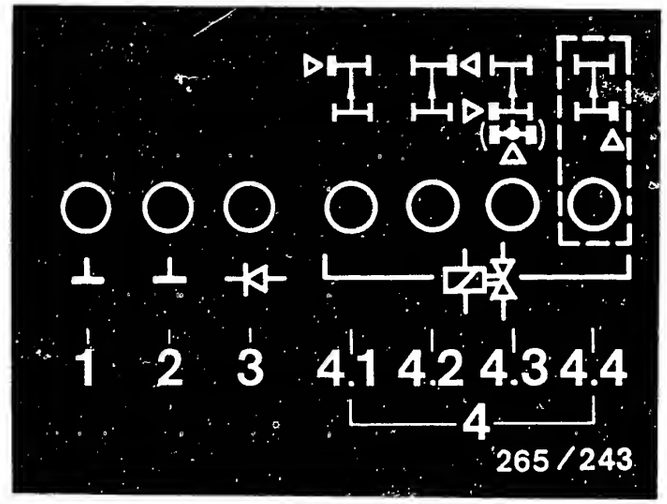

1 = LED(1) for indication of supply voltage

1 = Overvoltage-protection relay
2 = Valve relay

Rapid diagnosis chart (Continuation 1)

Program-selector-switch position 1 (3-channel hydraulic modulator)

| Test on (measurement at terminals) | Additional operation | Test specification (reading) | Possible causes of trouble (see coordinate) |
|---|---|---|---|
| Ground (term.10, term.4.3)<br><br>Diode for warning lamp (term.29, term.32)<br><br>Solenoid-operated valve – internal resistances (term.35, term.C21, term.18) Off-position and ground of valve relay<br><br>ABS warning lamp | Ignition on | 6 LED (34 to 1) light up equally brightly (upper illustration)<br><br>ABS warning lamp in vehicle must light up | * LED 1 and / or 2 (upper illustration) do not light up:<br>Check ground terminals for short circuit. (C19)<br><br>* LED 3 (upper illustration) does not light up: Diode defective, check ground of valve relay. (2)<br><br>* One or more LED 4 do not light up: Check corresponding plug connection for solenoid-operated valve and leads. (C21)<br><br>Solenoid-operated valve, internal resistance 0,7...1,7 Ω<br><br>* All LED 4 and LED 3 do not light up: Check ground of valve relay, valve relay defective. (C23)<br><br>* Weak lighting of a LED means contact resistance in corresponding current path. (C23)<br><br>ABS warning lamp does not light up: Warning lamp defective.<br>Note: All other 6 LEDs light up (C23) |



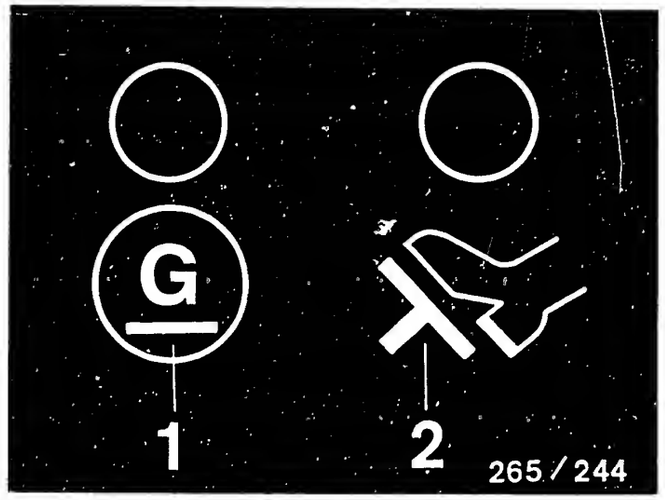

LED 1 and 2 ground indication
LED 3 diode for warning lamp indication
LED 4 internal resistance of solenoid valves
LED 4.1 to 4.4 indication for wheel selection

1 = Overvoltage-protection relay
2 = Valve relay

RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 2

| Testing of (measurement at terminals) | Additional operation | Test specification (reading) | Possible causes of trouble (see Coordinate) |
|---|---|---|---|
| Generator voltage from term.61 (term. 15) | Ignition on | LED 1 (top picture) lights up. | * In some cases, LED 1 does not go out until after burst of throttle (test is then O.K.) (D3)<br>* Check lead to generator term.61 |
| | Start engine | LED 1 (top picture) goes out when engine running | * Generator defective |
| Stop-lamp switch (term.25) | Ignition on | LED 2 (top picture) lights up | * Check lead to stop-lamp switch (D5)<br>* Stop-lamp switch defective |
| | Press brake pedal | LED 2 (top picture) goes out | * Lead on stop-lamp switch incorrectly connected |



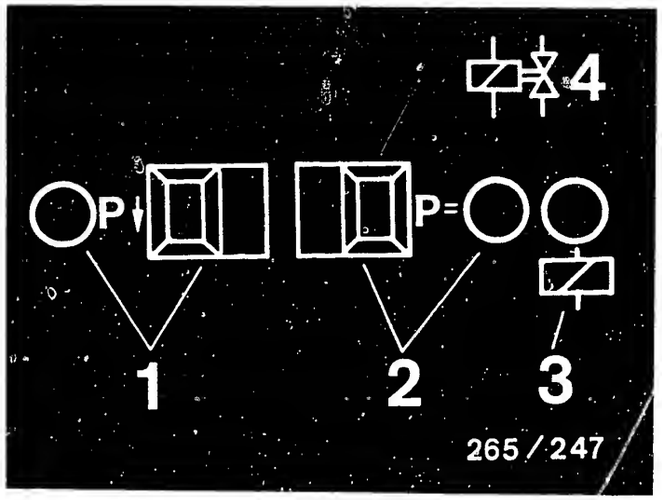

1 = LED indicator for connection to alternator term.61

2 = LED indicator for connection to stop lamp switch

Program-switch positions 3 und 4 not applicable.

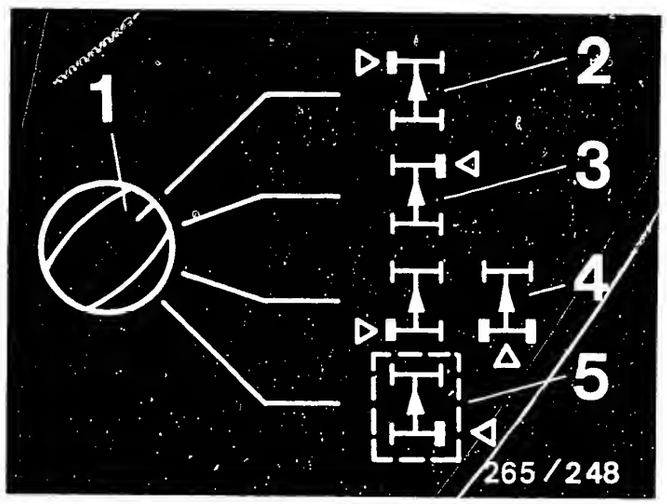
Rapid diagnosis chart (Continuation 4)
Program-selector-switch position 5 (3 channel hydraulic modulator)

| Test on (measurement at terminals) | Additional operation | Test specification (reading) | Possible causes of trouble (see coordinate) |
|---|---|---|---|
| Valve relay operation (term.27) | Ignition on | LED 3 (upper illustration) lights up | Valve relay (winding) or leads defective (D07)<br>* Repeat test with engine running<br>* Valve relay (make contact) defective (D07)<br>* Break in line from valve relay term. 87 to B+ (D07)<br>* Brake leads at hydraulic modulator mixed up (D11)<br>* Current value not obtained (LED P arrow or P= go out; upper illustration): Battery insufficiently charged. Repeat check with engine running. (D09)<br>* Solenoid-operated valves correctly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18 (D11)<br>* Hydraulic modulator defective(D13) |
| Solenoid-operated valves in hydraulic modulator for function and mix-up. NOTE: Check each wheel seperately in turn. Keep to operating sequence | Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set Switch 1 for wheel selection to wheel to be tested. (Lower illustration) | | |
| Operation pressure holding | 1. Constantly press push-button P= (upper illust.) | LED P= (upper illustration) lights up | |
| | 2. Constantly press brake pedal | Wheel turnable by hand | |
| | 3. Release push-button P= (upper illustration) | LED P= goes out (upper illustration) Wheel locks | |
| Operation pressure reduction | 4. Press push-button P arrow (upper illustration) | LED P arrow (upper illustration)lights up, wheel turnuble by hand | |
| | 5.Release push-button P arrow (upper illustration) | LED P arrow (upper illustration) goes out, wheel locks | |
| | 6.Release brake pedal | | |




Button and LED indication
1=Pressure-reduction function
2=Pressure-holding function
3=Indication of valve-relay operation
4=Symbol for solenoid valves

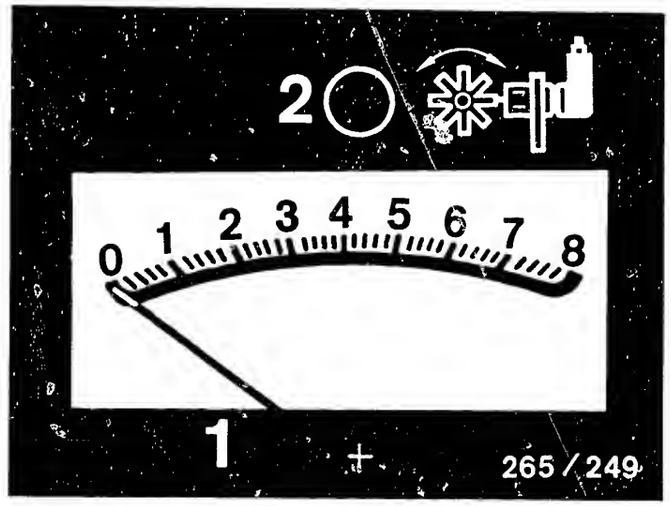
1 = Wheel-selector switch
2 = Front left wheel
3 = Front right wheel
4 = Rear left wheel or rear axle
5 = Rear right wheel



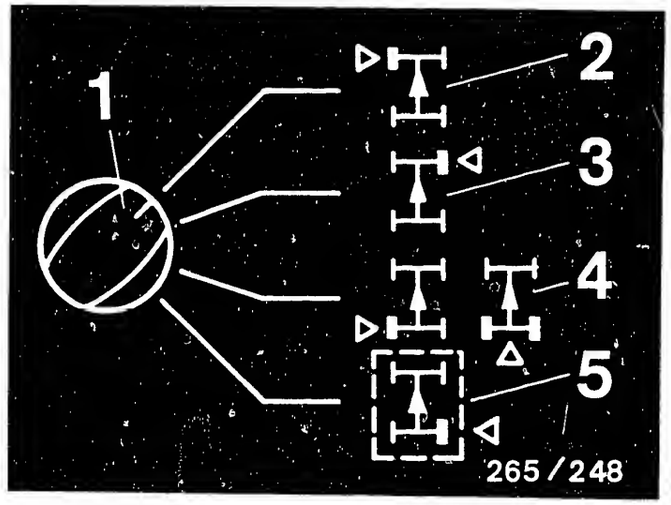
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 6 (4 wheel-speed sensors)

| Testing of (measurement at terminals) | Additional Operation | Test specification (reading) | Possible causes of trouble (see Coordinate) |
|---|---|---|---|
| Wheel-spped sensors for operation and mixing-up<br><br>NOTE:<br>Perform test separately for each wheel one after the other.<br><br>(Front left wheel: term.5 and term.4<br><br>Front right wheel: term.11 and term.21<br>Rear left wheel: term.8 and term.9<br>Rear right wheel: term.24 and term.26) | Chock up vehicle.<br><br>Ignition on.<br><br>The wheel under test must be freely rotatable by hand.<br><br>When testing the driven axle, the wheel that is not under test must be held still.<br><br>Set switch for wheel selection to the wheel under test (bottom picture)<br><br>Turn wheel by hand until LED 2 above the instrument comes on without flickering. (wheel speed approx. 1 revolution per second).<br><br>Then make reading on instrument: (top picture) | 1. Smallest reading greater than 1,6 scale divisions<br><br>2. Allowable fluctuation range max. 25 % of highest reading. | *Wheel-speed sensor leads mixed up (D19)<br>*Open circuit in wheel-speed sensor lead (D25)<br>*Wheel-speed sensor defective (D25)<br>Winding resistance<br>Front axle:<br>0,6...1,6 k Ω<br>Rear axle:<br>0,6...1,6 k Ω<br><br>*Air gap between wheel-speed sensor and ring gear too big (D23)<br>*Ring gear defective or loose (D23)<br>*Ring gear with incorrect no. of teeth installed<br>Front axle: 48 teeth<br>Rear axle:<br>varying number of teeth on propshaft, depending on transmission ratio (D23)<br><br>*Wheel-bearing play too great |

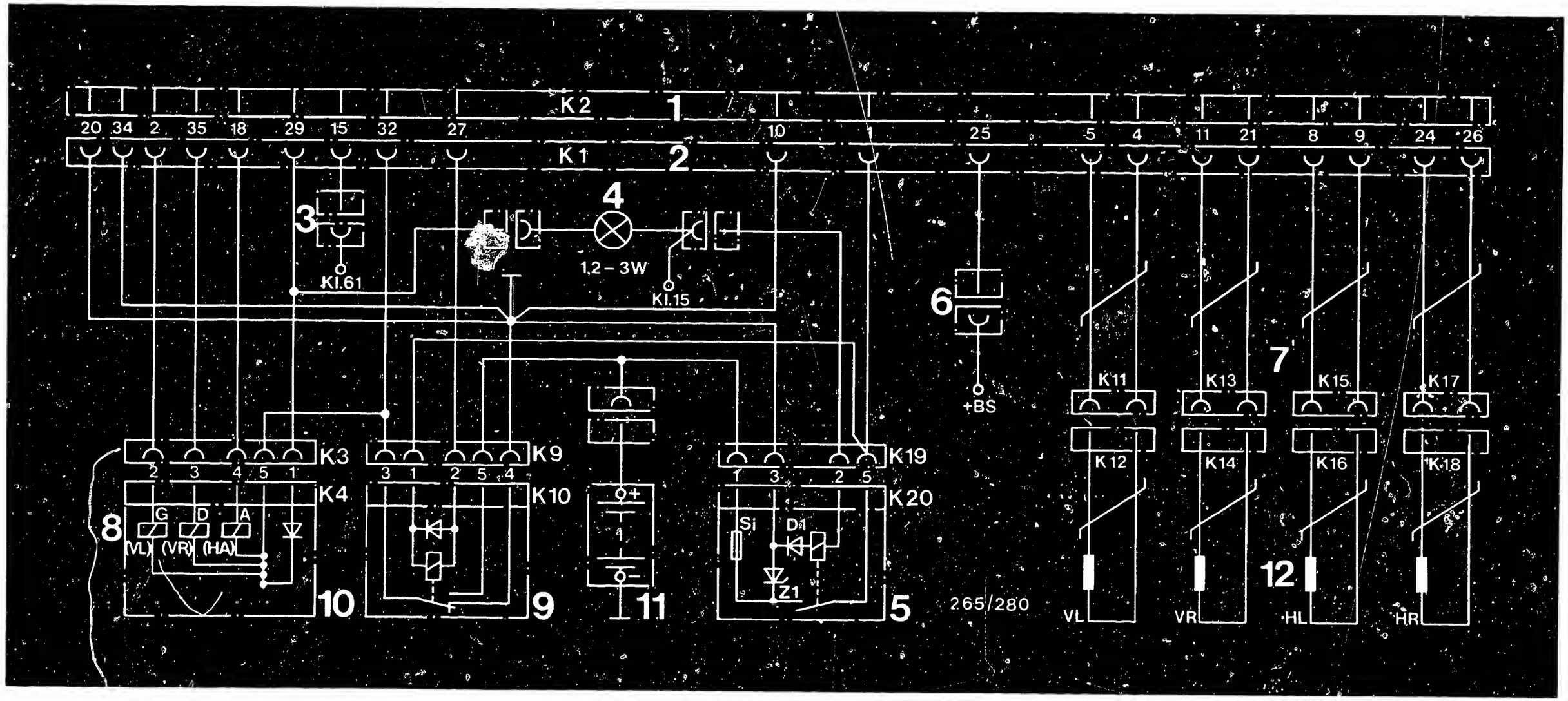



1 = Instrument
2 = LED for wheel speed




1 = Wheel-selector switch
2 = Front left wheel
3 = Front right wheel
4 = Rear left wheel or rear axle
5 = Rear right wheel

Finally, perform a road test. With the engine running, the warning lamp must go out. Drive at at least 30 km/h. The warning lamp must not come on again!




1 = ABS controller
2 = Multiple plug (35–pin)
3 = to alternator (term.61)
4 = ABS warning lamp
5 = Overvoltage–protection relay
6 = to stop–lamp switch (+)
7 = Cable connector
8 = Solenoid valve
9 = Valve relay
10 = Hydraulic modulator
11 = Battery
12 = Wheel–speed sensor

VL or G = front left
VR or D = front right
HA or A = rear axle
HL = rear left
HR = rear right
K1 to K18 = ABS plug–in connections

ELECTRICAL TERMINAL DIAGRAM

A15 ⟹

A16 ⟸

TEST EQUIPMENT AND TOOLS

| Description | Designation | Part Number |
|---|---|---|
| ABS-2-LED tester | KDAS 0003 | Order from:<br>Robert Bosch GmbH<br>KH/VKD 3<br>Postfach 41 09 60<br>7500 Karlsruhe 41 |
| Adapter lead (included with tester) | KDAS 0003/2 | |
| Pressure gauge | KDHB 0002 | |
| Adapter for connection to pressure regulator | KDHB 0002/4 | |
| Adapter for connection to bleeder screw | KDHB 0002/5 | |
| Brake-pedal actuating device | | ATE Part No. 3.9312.0100.4 1) |
| Vessel approx. 1l for catching LHM mineral oil | | |
| Double-head box wrench open 8 x 10 mm and 9 x 11 mm | | Hazet Part No. 612 2) |

1) obtainable from: Alfred Teves GmbH Guerickestr. 7
D-6000 Frankfurt (Main)

2) obtainable from: Firma Hazet, D-5630 Remscheid

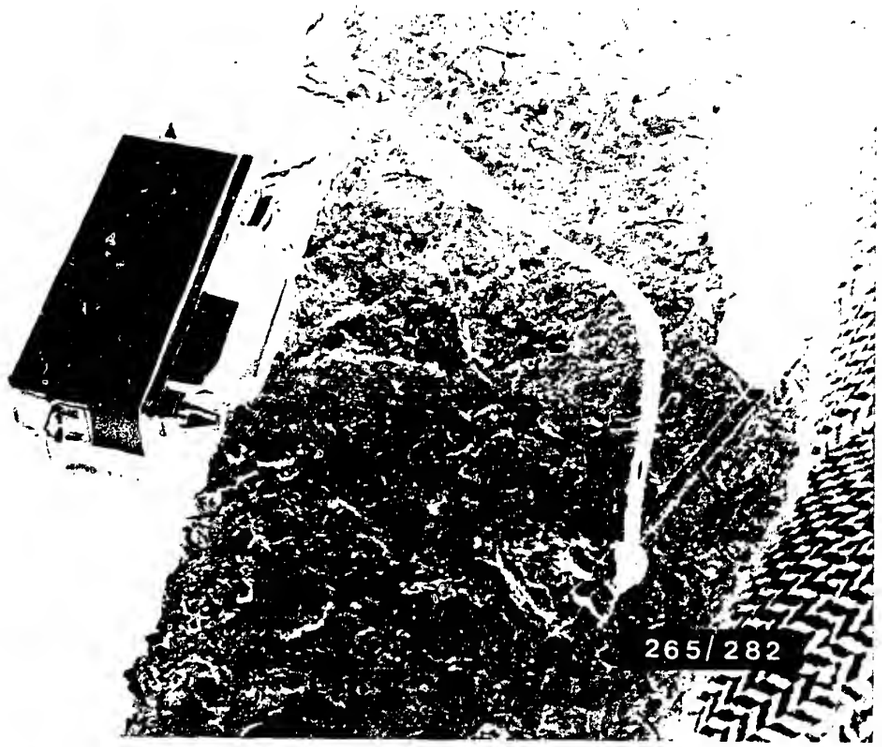


Test equipment and tools (continued)

| Description | Designation | Part Number |
|---|---|---|
| Electric tester<br>or<br>multimeter<br>for trouble-shooting | ETE 014.00 | 0 684 101 400<br><br>commercially available |
| Mineral oil<br>Use only LHM mineral oil. If LHM is mixed with LHS 2, this will lead to the immediate destruction of all rubber parts. | | |

Auxiliaries!
Use only genuine brake lines from the vehicle manufacturers!

| | |
|---|---|
| Grease for wheel-speed sensors | Molykote Longterm 2 |
| Protective caps for brake lines | Citroen |
| Protective caps for brake-line connections on hydraulic modulator | 2 260 522 001 (100 pieces) |
| Rubber sleeves for hydraulic lines | Citroen |




INSTALLATION POSITION OF COMPONENTS

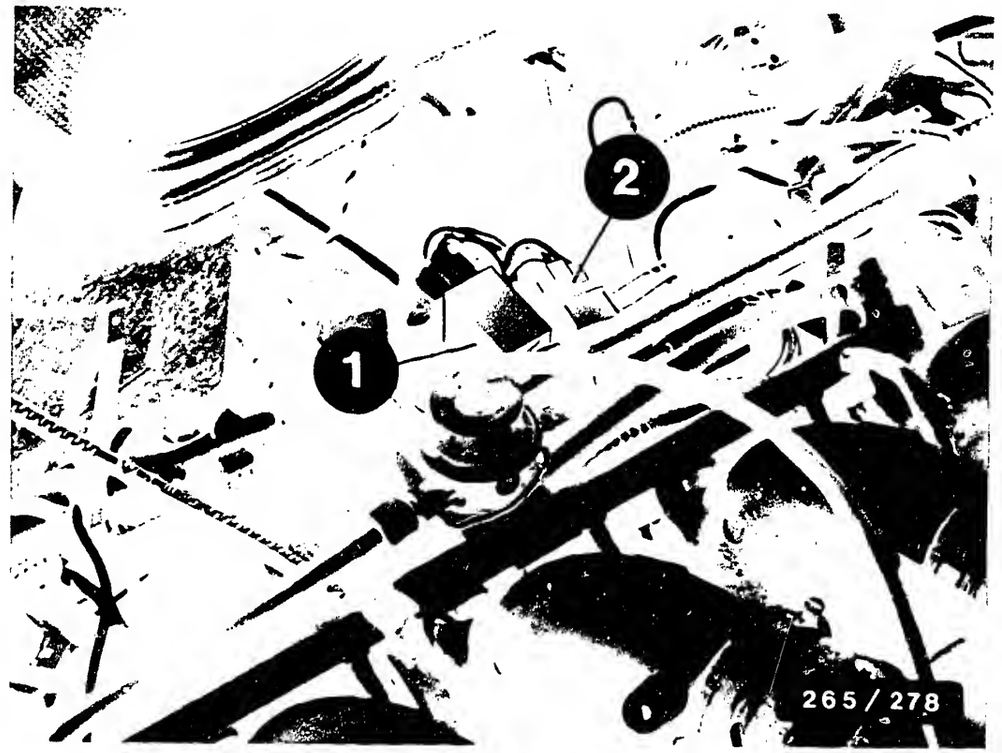
The indications "right" and "left" refer always to the forward direction of travel.

Controller:
Under rear seat bench on left (top picture).

Overvoltage-protection relay: picture on right (1)
In engine compartment under spare wheel to right of hydraulic modulator above cross-member.
Valve relay: picture on right (2)
In engine compartment under spare wheel to right of hydraulic modulator above cross-member.

ABS warning lamp:
In instrument panel (not shown).
ABS ground terminal:
In passenger compartment on center console under radio panel (not shown).



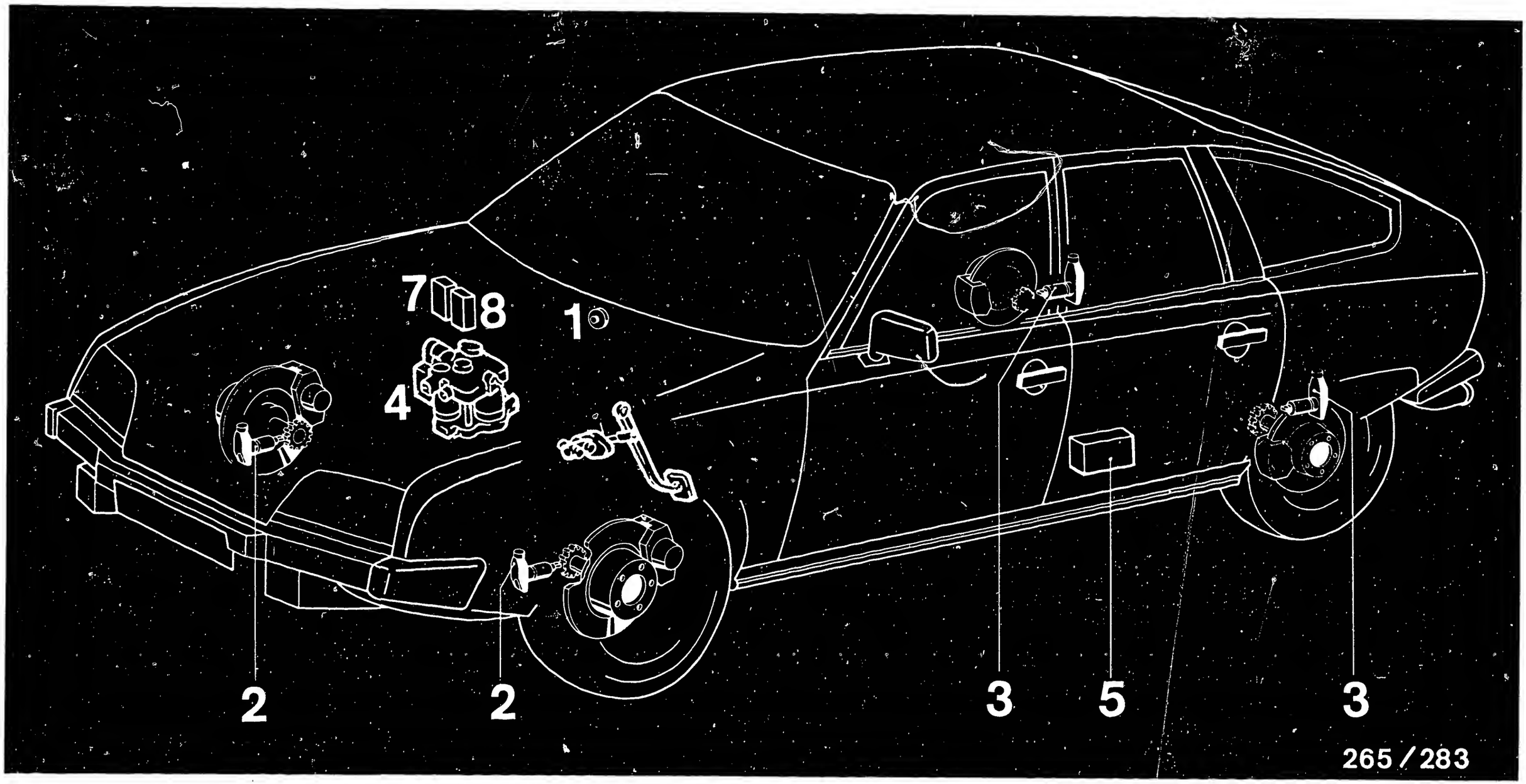



* Front-axle wheel-speed sensors:

One each on left and right opposite the brake caliper. Plug-in connections near the right-hand and left-hand suspension ball above the cross-member. Top picture.

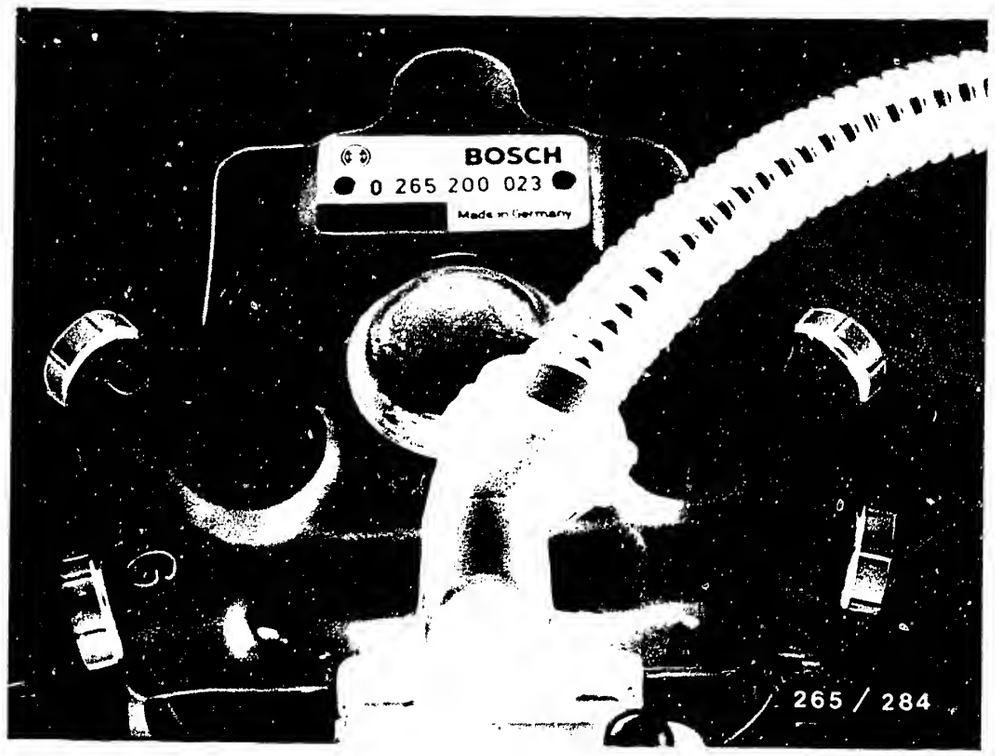
* Rear-axle wheel-speed sensors:

One each on left and right opposite the brake caliper. Plug-in connections under rear seat bench on left and right near the controller (not shown).




1 = ABS warning lamp
2 = Front-axle wheel-speed sensor
3 = Rear-axle wheel-speed sensor
4 = Hydraulic modulator
5 = Controller
6 = Overvoltage-protection relay
7 = Valve relay

Installation position of components in CITROEN CX 25 GTi Turbo.




Hydraulic modulator:

(Behind a cover under the spare wheel behind the cross-member in the engine compartment)

G = Brake line to front left wheel-brake cylinder
R = Brake line to front right wheel-brake cylinder
A = Brake line to rear-axle wheel-brake cylinders
D = Return

The hydraulic modulator must not be repaired, but must be replaced only as a complete unit.



## BLEEDING THE BRAKE SYSTEM

After the hydraulic modulator has been replaced, bleed the brake system and perform a pressure test.

Caution when handling mineral oil!

a) Pour mineral oil only into containers from which there is no possibility of the liquid being drunk by mistake (W a r n i n g, p o i s o n o u s !)

b) Even slight traces of brake fluid will lead to the failure of the brake system. If brake fluid is found in the brake system or if you suspect brake fluid, flush the entire brake system thoroughly with mineral oil.

Note:

In the course of operation, the boiling point of the mineral oil drops due to the constant absorption of moisture from the atmosphere. Very heavy use of the brakes may therefore lead to the formation of vapor locks in the brake system. The mineral oil must be replaced every 30 000 km or once a year, in spring if possible.

## Bleeding

* When bleeding the brake system on the Citroen CX 25 GTi Turbo it is not necessary to use any special bleeding device, but only a collector vessel and a transparent hose.

Front-wheel brakes

* Chock up vehicle and remove wheels.

* Loosen pressure-regulator bleeder screw; drain main pressure accumulator.

* Place transparent hose on bleeder screw at brake caliper.

  To drain the brake-pressure accumulator, slightly loosen one of the bleeder screws on the brake caliper and depress brake pedal.

* Loosen bleeder screw, start engine and run at idle.
  Tighten pressure-regulator bleeder screw moderately by hand.

* Bleeding is completed when the mineral oil flowing through the bleeder hose is free from bubbles. Close bleeder screw again and tighten moderately by hand.

Rear-wheel brakes:

Bleeding is performed under pressure

* Chock up vehicle. Remove wheels

* Let off rear spring pressure

* Provide each bleeder screw with a transparent hose.

* Set to maximum ground clearance.



Bleeding rear-wheel brakes (continued)

* Raise one of the trailing arms.

* Loosen bleeder screws.

* Slowly depress brake pedal. Start engine and run at idle. Bleed until the mineral oil escaping is free from bubbles.
  Finger-tighten bleeder screws and tighten moderately

* Mineral-oil reservoir must be filled with mineral oil to "maximum" mark after bleeding.


LEAK TEST ON BRAKE SYSTEM

* Loosen screw on pressure regulator (picture, arrow) and remove. Screw in adapter KDHB 0002/4 and connect pressure gauge KDHB 0002.

* Start engine and watch pressure gauge.

  Set value for cut-in pressure 140...150 bar
  " " cut-off pressure 165...175 bar

* For pressure measurement, screw in adapter KDHB 0002/5 on brake caliper and connect pressure gauge KDHB 0002.

  Set value for brake pressure 62 $^{+\ 2}_{-32}$ bar



GENERAL INFORMATION FOR REPAIRS AND ON BRAKE SYSTEM

The ABS is basically maintenance-free, however, when working on vehicles with ABS system the following must be noted:

1. When welding with electric welding equipment, pull plug from electronic controller.

2. When painting, the electronic controller may be loaded for a short time to max. + 95°C and for a long time (approx. 2 hours) to max. 85°C.

3. After exchange of hydraulic modulator, controller, wheel-speed sensor and of the wiring harness, as well as after work in which the ABS units are touched (e.g. accident repairs), check the complete ABS system with the tester.
   Pay attention to correct assignment of brake lines and wheel-speed-sensor connections at controller as well as wheel-speed-sensor plug connections (see vehicle-specific terminal diagram).

4. Each time after working on the brake system, the latter must be bled and go through low-pressure and high-pressure tests. Check all connections for leaks..

5. Tighten battery terminals to terminal posts of battery.

6. Do not use a fast charger for starting the engine.

7. Never disconnect the battery from the vehicle electrical system when the engine is running.

8. Disconnect battery from vehicle electrical system when fast-charging.

9. Make sure that all connectors of wiring harness are correctly seated.

10. Never connect or disconnect ABS wiring harness plug from controller with ignition on.

11. For safety reasons, the hydraulic modulator must not be repaired, but must be replaced only as a complete unit. An exception to this is the valve relay. Apart from the brake-line connections, no screws or bolts on the hydraulic modulator may be loosened. After loosening, it is no longer possible to get the brake circuits leak-tight!

D a n g e r !

For production reasons:
continued on the following coordinate.

OPERATION OF ABS WARNING LAMP

Vehicles equipped with ABS come into the workshop with one of the following customer complaints:

* Warning lamp not lighting up after switching on ignition.

* Warning lamp n o t going out after reaching a vehicle speed of above 6 km/h (previously) or after reaching idle speed (new).

* Warning lamp coming on again during driving or coming on occasionally.

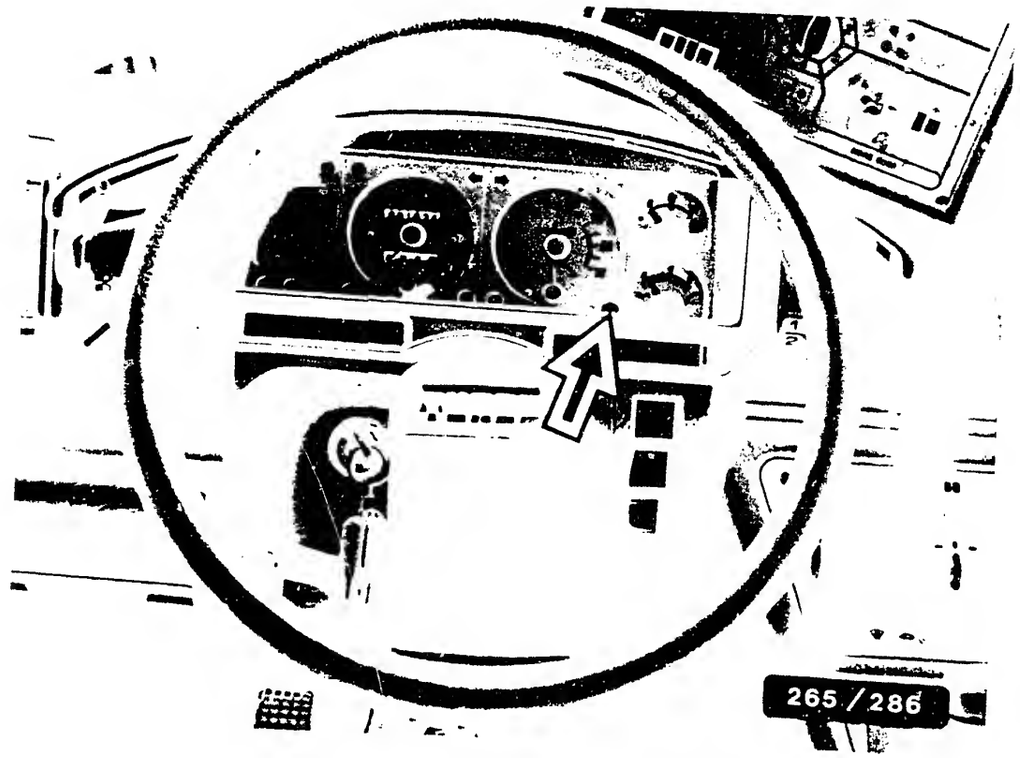
Check the complaint for yourself before checking the entire ABS system with the ABS 2 LED tester.

For safety reasons, the ABS must be tested only with the ABS 2 LED tester.

The ignition must always be off for connecting the ABS 2 LED tester and also for connecting and disconnecting the controller.

In the following, you are informed about the operation and malfunctioning of the ABS warning lamp.






ABS = ABS warning lamp in instrument panel

ABS warning lamp

When the ignition is switched on, the warning lamp, marked with the letters "ABS", lights up.
When the engine starts and reaches idle speed the ABS warning lamp goes out (terminal 61 of generator supplies voltage to ABS controller).
As soon as all 4 wheels of the vehicle exceed a speed of approx. 6 km/h for the first time after starting, the ABS system tests itself automatically (BITE sequence).
This procedure is repeated every time the ignition is switched off and the engine started up again. In addition, the ABS constantly tests itself to a certain extent while the vehicle is travelling.

If the ABS system is defective, the warning lamp comes on continuously no later than after the vehicle speed has exceeded 12 km/h. (At 12 km/h the wheel-speed sensor voltages are checked).

Continuous illumination of the warning lamp informs the driver that the ABS is off.

The normal brake system remains in operation.

Incorrect warning-lamp indications are:

* Warning lamp does not come on after ignition has been switched on.
* Warning lamp does not go out after idle speed has been reached.
* Warning lamp comes on again during driving or comes on occasionally.

The lighting-up of the ABS warning lamp informs the driver that the ABS is not in working order.

Nevertheless, it is still possible to brake with the conventional brake system. It is, however, possible for the wheels to lock. This applies in the case of a malfunction.

The causes of the trouble should be established with the aid of the ABS 2 LED. tester.

General note:
Occasional lighting-up of the warning lamp may be caused by an insufficiently charged battery.
The lamp lights up only as long as there is undervoltage, e.g. after electrical devices have been switched on with the engine idling.



OPERATION OF ABS 2 LED TESTER

1. General

The BOSCH ABS 2 LED TESTER checks the ABS components in passenger cars with hydraulic brake systems.

The following BOSCH ABS systems can be checked:

* All ABS 2 versions (currently ABS 2, ABS 2 B)

* ABS 2 B part of electronic traction control (ETC)

In 6 Program steps, the tester tests the peripheral components of the system:

* Hydraulic modulator
* Motor relay
* Valve relay
* Wheel-speed sensors
* Warning lamp
* Acceleration sensor
* Wiring harness
* Plug-in connections
* Ground leads
* Stop-lamp switch signal
* Alternator signal

The ABS controller is not checked.

The self-diagnosis feature in the ABS controller dispenses with the need for additional testing of the controller with the tester.

A dynamic brake analyzer is not required for testing the ABS.

If a dynamic brake analyzer is used, there is the danger that the vehicle will jump out of the rollers!

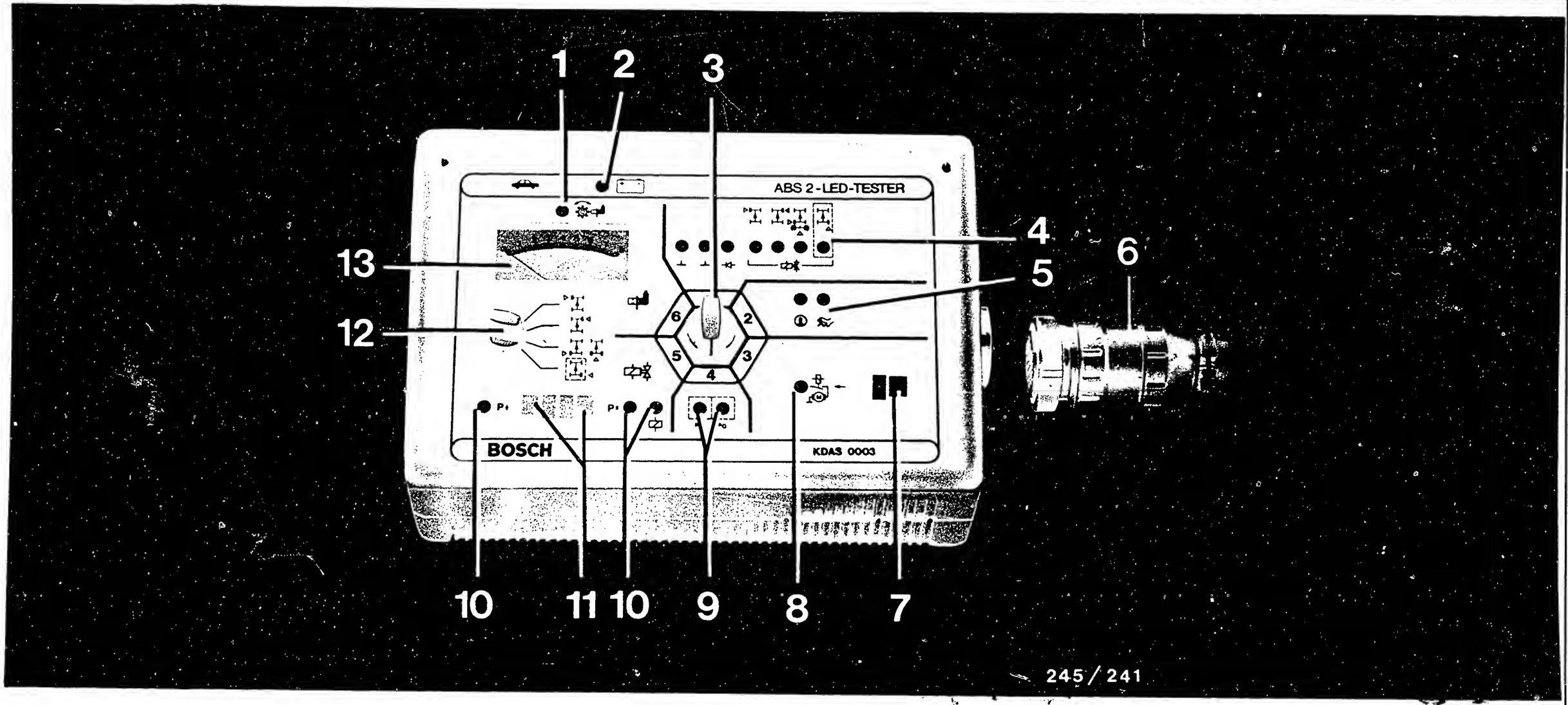
The responsibility for using a dynamic brake analyzer lies with the person performing the test.

2. Construction of tester

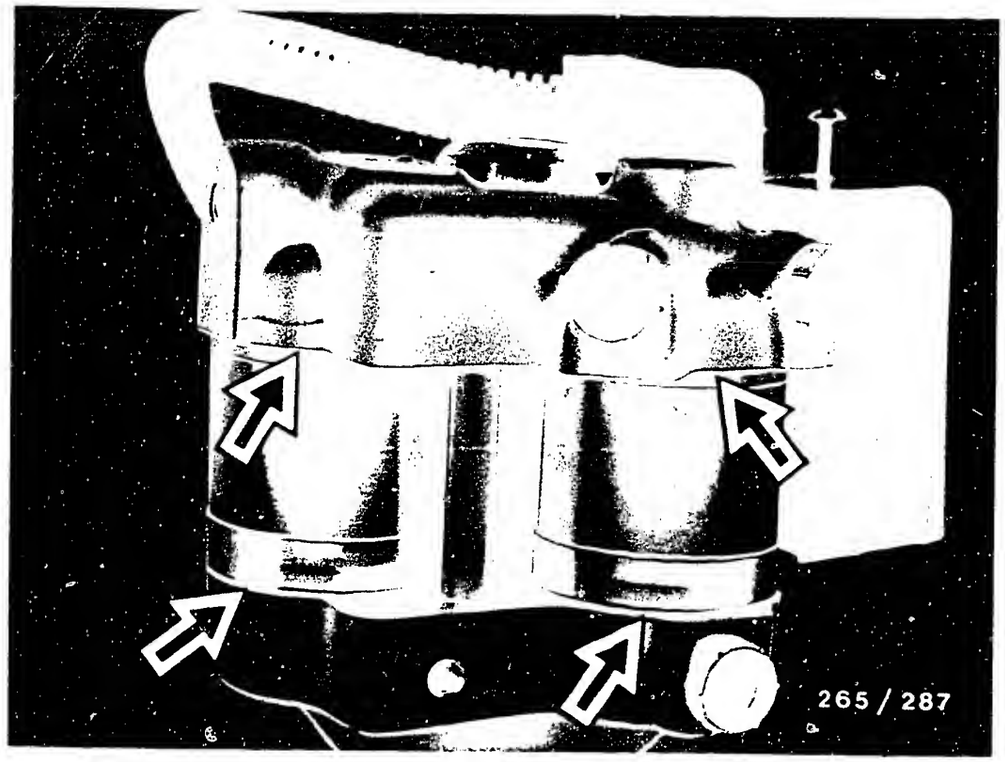
Faults are indicated by means of light-emitting diodes (LEDs) with the exception of the wheel-speed sensor signals, which are read off on the pointer instrument.



For production reasons: continued on the following coordinate.




1 =1 LED indicator for wheel speed in program-switch position 6
2 =1 LED indicator for battery voltage
3 =Program switch
4 =7 LED indicators for program-switch position 1
5 =2 LED indicators for program-switch position 2
6 =Adapter lead for connection to ABS wiring harness in vehicle
7 =Button for motor-relay energization in program-switch position 3
8 =1 LED indicator for program-switch position 3
9 =2 LED indicators for program-switch position 4
10 =3 LED indicators for program-switch position 5
11 =2 buttons for triggering solenoid-valve functions. Pressure-holding and pressure-reduction in program-switch position 5
12 =Rotary switch for selection of individual wheels. Operational in program-switch positions 5 & 6.
13 =Pointer instrument for program-switch position 6




TEST CONDITIONS FOR TESTING WITH ABS
2 LED TESTER

* Correct size of tire mounted?

* Check ground connection of overvoltage-protection relay term.3 for security and corrosion.

* Check hydraulic connections and joints on hydraulic modulator for leaks (visual examination, arrows).

* If, during driving, the ABS warning lamp comes on occasionally (e.g. after switching on electrical devices) and goes out again by itself, check battery and power supply (alternator, regulator and voltage drops)



* If the ABS warning lamp lights up continuously and does not go out, check the following points:

  - Is multiple plug correctly seated on controller and has it latched in?

  - All plug-in contacts O.K.?

  - Spring contacts latched in?

  - Check installation position of seal ring in controller plug for correct seating: round section to bottom.

  - Check wheel-speed sensor leads on controller plug for correct assignment.

Wheel-speed sensors:

front left at term. 5 and term. 4.

front right at term.11 and term.21.

rear left at term. 8 and term. 9.

rear right at term.24 and term.26.

Rear axle at term. - and term. -.

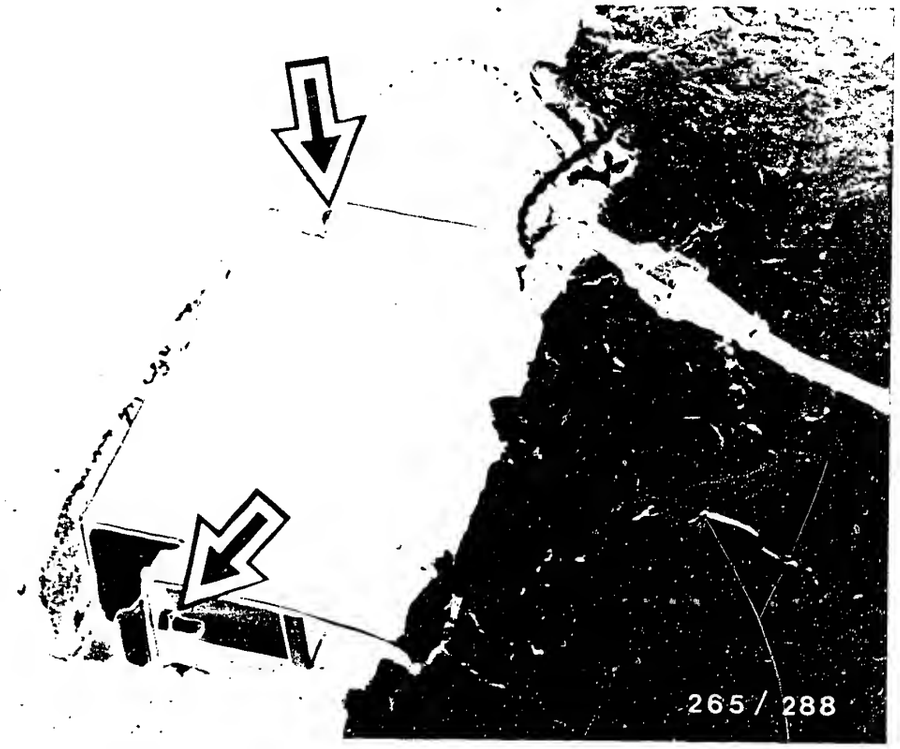
- V-belt broken?

(Alternator not supplying any voltage; charge indicator lamp and ABS warning lamp light up.

* For testing, switch on ignition in all program-switch positions (tester operates on power supply from vehicle battery).

* Watch LED (green) for power supply in all program-switch positions.

* Connect ABS 2 LED tester to ABS wiring harness.




Picture = Controller for ABS
Arrows = Fastening screws

* Connect LED tester to ABS wiring harness.

C A U T I O N !

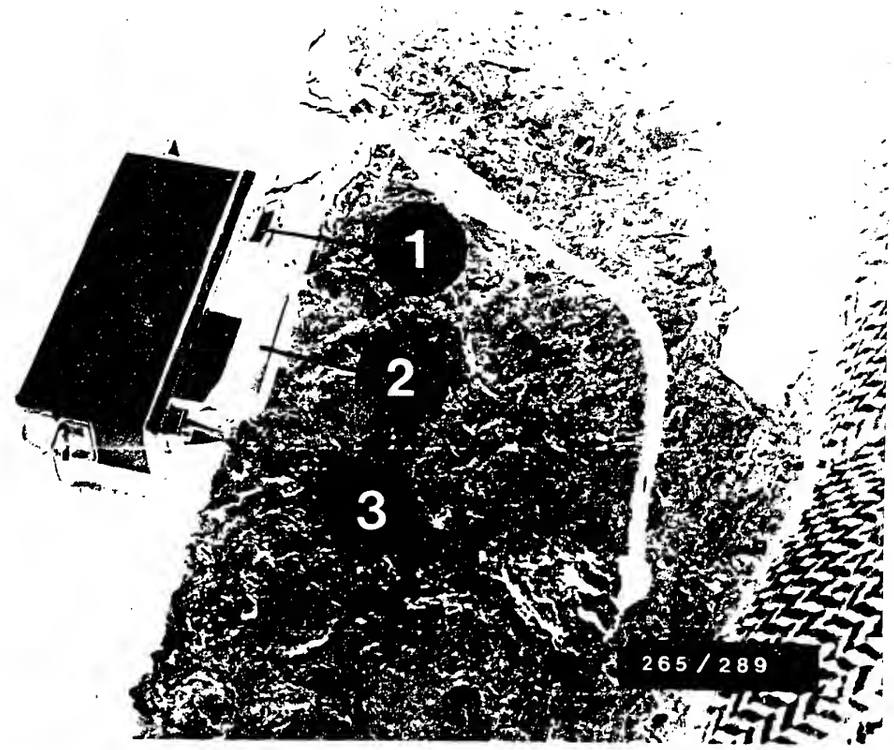
Connect and disconnect controller plug only with ignition off.

The controller is in the passenger compartment under the rear seat bench on the left.

To remove, loosen fastening screws of protection plate above controller and pull away protection plate upwards.

Loosen fastening screws and remove controller.






1 = Spring
2 = Multiple plug
3 = Encoding block

Switch off ignition before disconnecting multiple plug.

Press back spring, hinge up multiple plug and release from encoding block.

* For testing with LED tester, switch on ignition in all program-switch positions (tester operates on power supply from the vehicle battery).

* An LED constantly indicates whether the voltage is sufficient.

C A U T I O N !

Do not drive with tester connected!

After each repair, repeat the entire test program.

General note on trouble-shooting

Check all leads for short circuit to ground and for contact with positive leads, and watch for rubbing and pinching.



For production reasons:
continued on the following coordinate.

TEST STEP 1 ( TEST SPECIFICATIONS AND NOTES ON OPERATION )

V

* Component/Function:

  Power supply
  (term.20 and term.1)

* Operation:

| | Position |
|---|---|
| Prog. switch | all |
| Button | – |

* Operation in vehicle:
  Ignition on

* Test specification (reading)

  LED 1 in top picture constantly lit in all program-switch positions.

N>

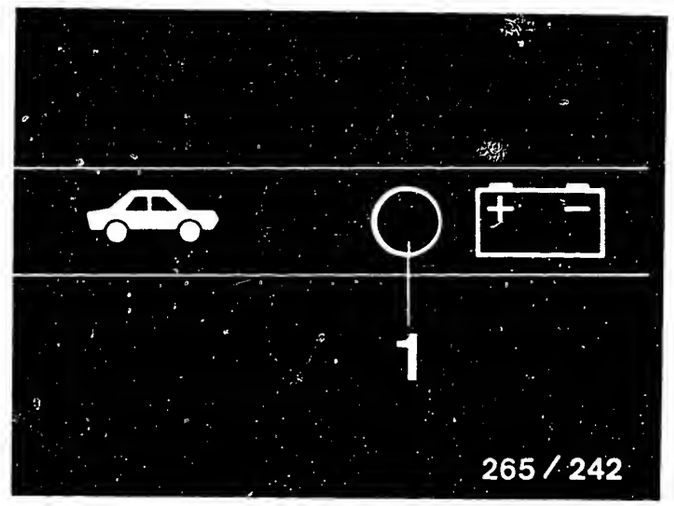
Trouble-shooting:

Switch off ignition!

* Fuse No.2 (25A) in fuse box defective.

* Multiple plug not properly connected.

* Overvoltage-protection relay defective: replace.




1 = LED(1) for indication of supply voltage

1 = Overvoltage-protection relay
2 = Valve relay


Y

Continued on next coordinate

V

Continued on next coordinate

Check the following leads:

* Positive lead from B+ to overvoltage-protection relay term.30 .
* Negative lead from overvoltage-protection relay term. 31 to ground.
* Negative lead from ABS ground to multiple plug K1/term. 10 .
* ABS ground must be bare down to the metal and must not have any contact resistance.
* Positive lead from overvoltage-protection relay term.30a to multiple plug K1/term.1.
* Positive lead from overvoltage-protection relay term.86 to driving switch term.15 .
* Check ground strap between engine block and vehicle frame for security.

LED 1 (green) lights up occasionally during testing:

Discontinue testing and rectify fault.

Causes of fault:

1. Battery insufficiently charged. Charge battery or let engine warm up.
2. High voltage drops at ABS ground terminal; ground terminal must be bare down to the metal.

After rectification of fault perform complete test program.


Arrow=Ground terminal for ABS below radio installation position on center console

1 = Overvoltage-protection relay
2 = Valve relay

TEST STEP 2 ( TEST SPECIFICATIONS AND NOTES ON OPERATION )

V

* Component/Function:

Ground connection
(term.34, term.10).
Diode for warning lamp
(term.29, term.32)
Sol. valve int. resist.
(term.2, term.35, term.18)
Off-position and ground
connection of valve relay.
ABS warning lamp

* Operation:

| | Position |
|---|---|
| Prog. switch | 1 |
| Button | - |

* Operation in vehicle:
Ignition on

* Test specification (reading)
LED 1 to LED 4.3 light up
with equal brightness.
Top picture.
ABS warning lamp in vehicle
must light up.

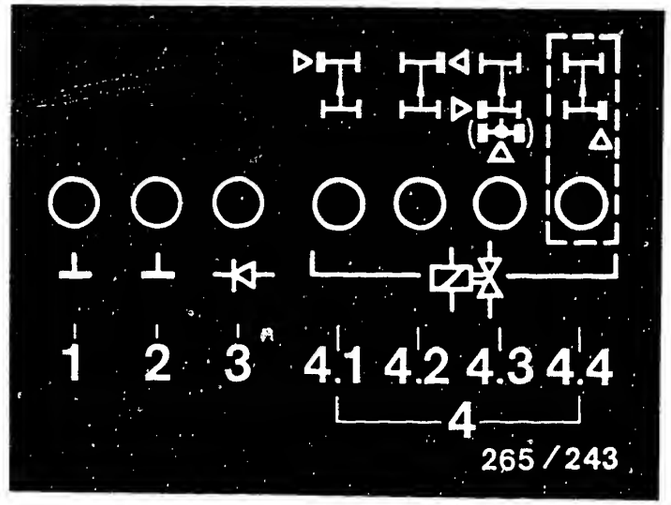
N>

Trouble-shooting:

Switch off ignition!

1. LED 1 and/or 2 (top picture) not lit:

* Check ground terminal on intake manifold as well as ground strap between engine block and vehicle frame for security, high contact resistance and open circuit.




LED 1 and 2 ground indication
LED 3 diode for warning lamp indication
LED 4 internal resistance of solenoid valves
LED 4.1 to 4.4 indication for wheel selection

Arrow=Ground terminal for ABS below radio installation position on center console


V

Continued on next coordinate

V

Continued on next coordinate

* Check ground lead from multiple plug K1/term.10 and term.34 to vehicle ground for open circuit and contact resistance.

* Valve relay defective.
  Caution!
  Use only relay with correct electrical terminal assignment.

2. LED 3 not lighting up:

* Check diode in forward and reverse directions with ohmmeter between K4/term.10 and K4/term.5 .
  If diode defective, replace hydraulic modulator.

* Check ground connection of valve relay for open circuit and contact resistance.
  From plug K9/term.4 to ground terminal.

3. One or more LED 4's not lighting up:

* Measure internal resistance directly at hydraulic modulator:

| | Test spec |
|---|---|
| Valve VL (LED 4.1) between K4/term.2 and K4/term.5 | 0,7...1,7 Ω |
| Valve VR (LED 4.2) between K4/term.3 and K4/term.5 | 0,7...1,7 Ω |
| Valve HA (LED 4.3) between K4/term.4 and K4/term.5 | 0,7...1,7 Ω |

Test specification not obtained: replace hydraulic modulator.

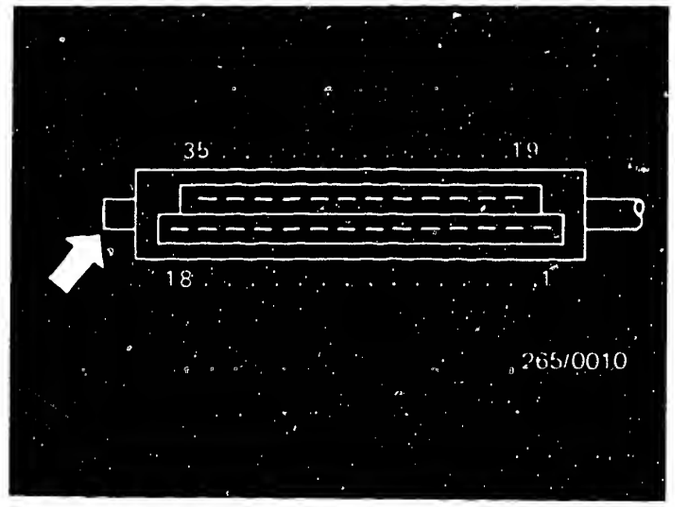
* Check leads for continuity: set value 0 Ω .

  Valve VL (LED 4.1) between K4/term.2 & multiple plug K1/term.2
  Valve VR (LED 4.2) between K4/term.3 & multiple plug K1/term.35
  Valve HA (LED 4.3) between K4/term.4 & multiple plug K1/term.18

Test specification not obtained:

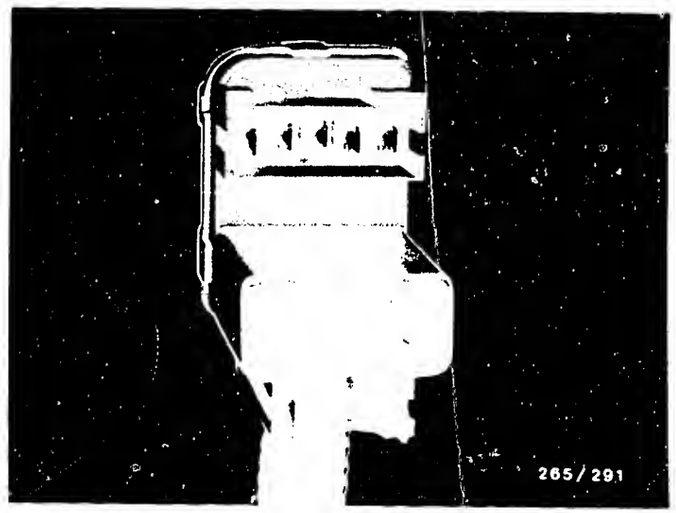
Check plug-in connections for open circuit, corrosion and mechanical defects. Eliminate open circuit.






Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding

Top view of plug-in connection on hydraulic modulator



4. All LED 4 and LED 3 not lighting up:

* Valve-relay ground connection for contact resistance and open circuit from plug K9/term.4 to ground terminal.

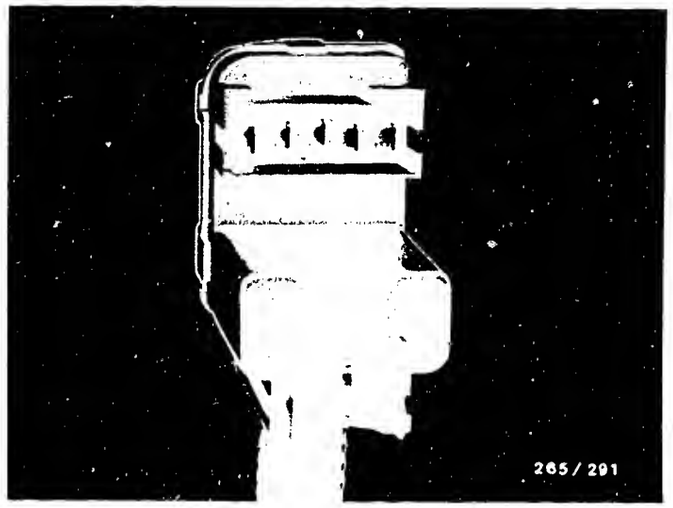
* Valve relay defective.

5. Dim lighting-up of an LED:

* This indicates a contact resistance in the corresponding circuit.

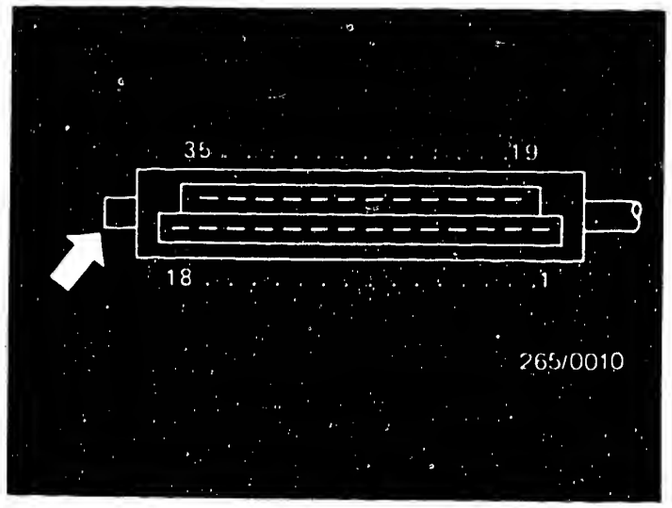
6. ABS warning lamp not lighting up:

* Warning lamp defective. Check lead to driving switch term.15 and controller term.29 .
Note: all other 6 LEDs must light up.




Top view of plug-in connection on hydraulic modulator

Top view of controller plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



Removal of hydraulic modulator:

* For safety reasons, the hydraulic modulator must not be repaired, but may only be replaced as a complete unit.

  An exception to this is the valve relay. The relay may be replaced. The valve relay is no longer directly situated on the hydraulic modulator.

* Apart from the brake-line connections, no screws or bolts on the hydraulic modulator may be loosened.

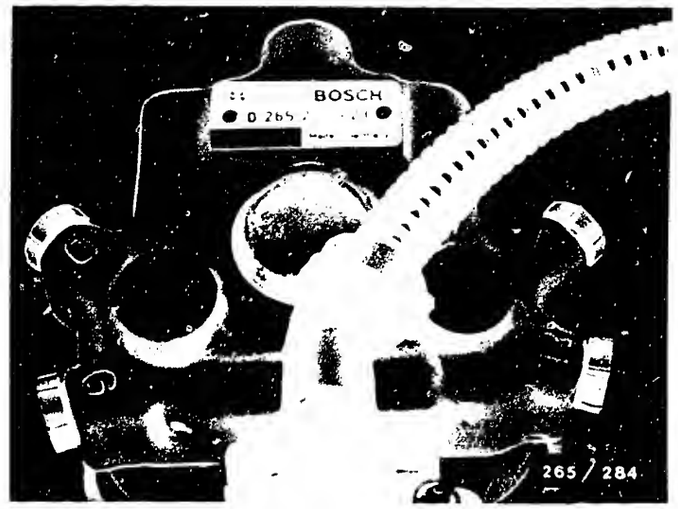
  Under no circumstances may the covered central screw (center of hydraulic modulator) be loosened.

  After loosening, it is no longer possible to get the brake circuits leak-tight!

  D a n g e r !

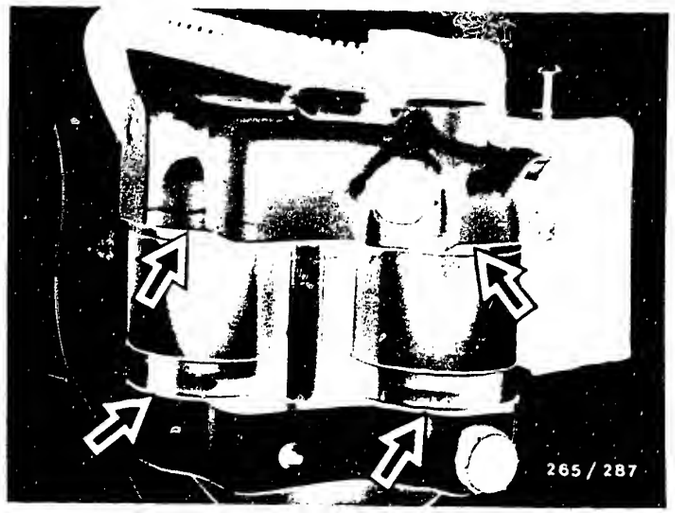
* Visually inspect hydraulic modulator and brake-line connections for leaks (see bottom picture).

If mineral oil is escaping, tighten the brake-line connections (screw on nut by hand and tighten moderately) or replace, or replace the hydraulic modulator.




Brake-line connections
G(VL) = Front left
D(VR) = Front right
A(HR) = Rear axle
R = Return

Joints, see arrows

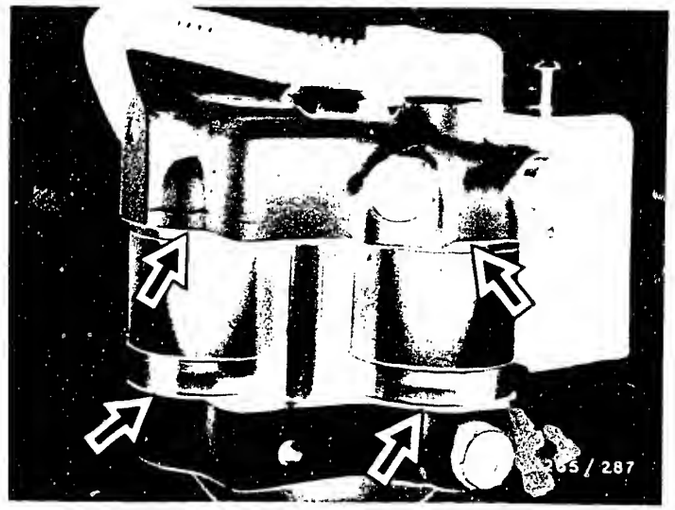


Pay particular attention to the joint identified by arrows (picture).

* When removing and installing the brake lines, make sure that the lines are marked according to the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. VL from hydraulic modualtor must be connected to the front left wheel-brake cylinder).
  CAUTION, when connecting, screw on nut by hand and tighten moderately.

* Markings on hydraulic modulator:

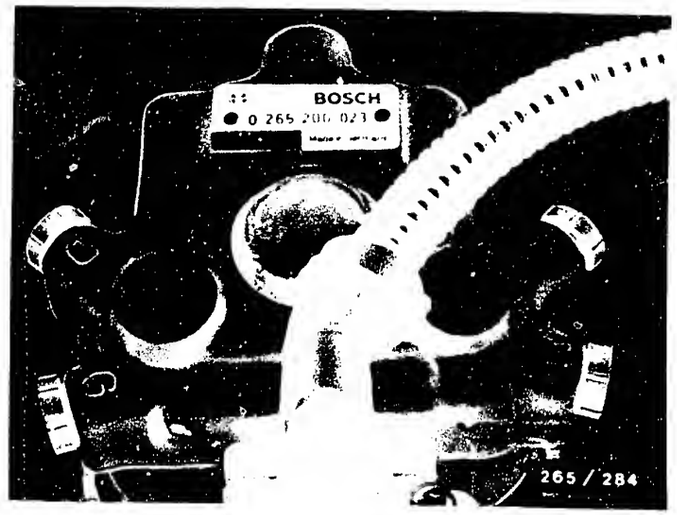
G(VL)=Connection for front left brake line (wheel-brake cylinder)
D(VR)=Connection for front right brake line (wheel-brake cylinder)
A(HR)=Connection for rear-axle brake line (wheel-brake cylinder)
R =Return connection to mineral oil reservoir




Joints, see arrows



Brake-line connections
G(VL) = Front left
D(VR) = Front right
A(HR) = Rear axle
R = Return



* For loosening and tightening the brake lines, use only the specified double-head box wrench 8 x 10 mm.

* Mark brake lines and loosen from hydraulic modulator.

* Catch mineral oil.

* Seal brake lines and connections immediately with dummy plugs.

Installation

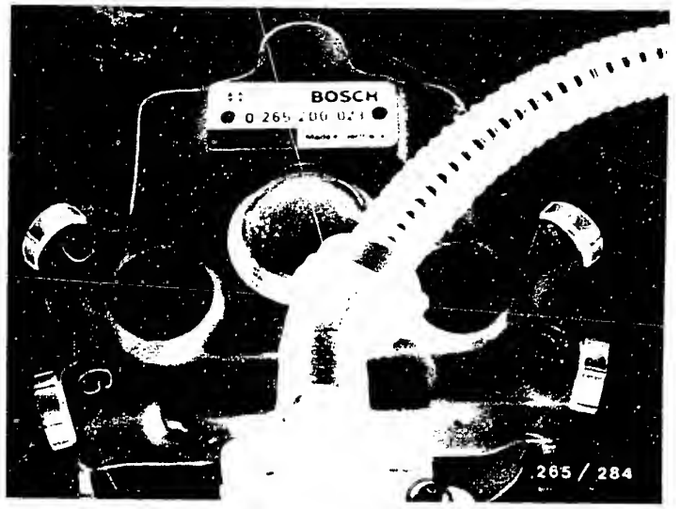
* Insert hydraulic modulator into the holder and fasten with the hexagon nuts.

* Connect brake lines, according to markings, to hydraulic modulator.

* Before connecting the brake lines, slide on new rubber sleeves with a clearance of approx. 2 mm from end of pipe. With sleeve moistened, center pipe in hole and check whether it goes all the way in. Screw on nut by hand and tighten moderately.

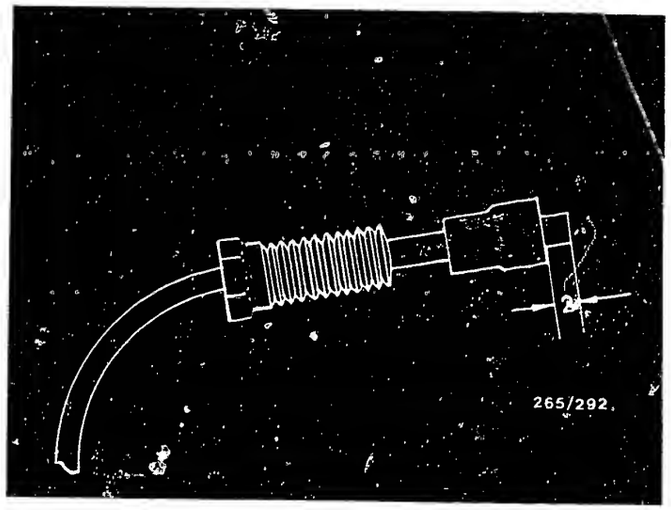
* Bleed brake system and check for leaks.

* Check ABS completely with LED tester.




Brake-line connections
G(VL) = Front left
D(VR) = Front right
A(HR) = Rear axle
R = Return

1 = Rubber sleeve
2 = Nut
3 = Brake line



TEST STEP 3 ( TEST SPECIFICATIONS AND NOTES ON OPERATION )

V

* Component/Function:

  Generator voltage from term.61 (term.15)

N>

* Operation:

| Position |
|---|
| 2 |
| — |

  Prog. switch
  Button

* Operation in vehicle:

  Ignition on

* Test specification (reading)

  LED 1 in top picture lights up.

* Operation in vehicle:

  Start engine

* Test specification (reading)

  LED 1 in top picture goes out when engine running.

Y

V

Continued on next coordinate

Trouble-shooting:

1. LED 1 does not go out when engine running:

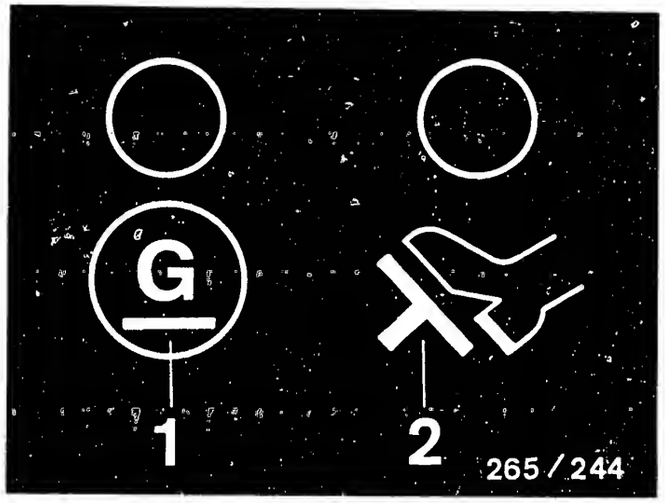
* Briefly accelerate engine; if LED 1 goes out, test is O.K.

* Voltage measurement at K1/term.15 with engine running.
  Test specification:
  greater than 10 V

* Oscilloscope measurement at K1/term.15 with engine running. BOTTOM PICTURE

* Voltage less than 10 V or pattern indicating defects.

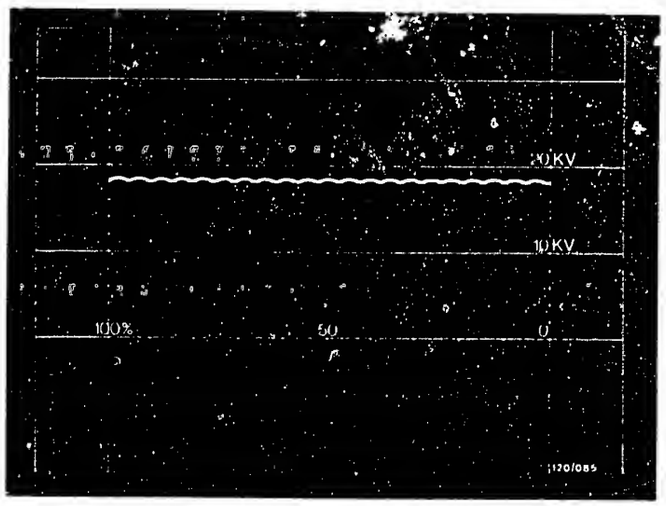
* Repair generator and/or lead.




1 = LED indicator for connection to alternator term.61

2 = LED indicator for connection to stop lamp switch

O.K. oscilloscope pattern of alternator



TEST STEP 3 (CONTINUED) (TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS)

V

* Component/Function:

  Stop-lamp switch term.25

* Operation:

| Position |
|---|
| 2 |
| – |

  Prog. switch
  Button

* Operation in vehicle:

  Ignition on

* Test specification (reading)

  LED 2 in top picture lights up.

* Operation in vehicle:

  Press brake pedal

* Test specification (reading)

  LED 2 in top picture goes out

N>

Trouble-shooting:

1. LED 2 does not light up.

* Stop lamps defective. High contact resistance of stop lamps or their ground connection.

  Open circuit in lead from controller term.25 to stop-lamp switch.

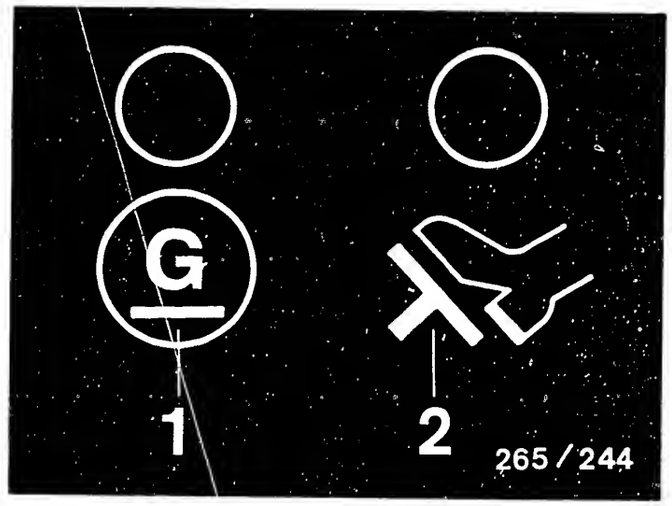
2. LED 2 does not go out or only becomes slighty dimmer.

* Fuse No.F2 (25A) for stop-lamp switch in fuse box defective.

* Voltage drop at stop-lamp switch (switch defective) or its plug-in connections

* Stop-lamp switch defective

* Lead to stop-lamp switch incorrectly connected.




1 = LED indicator for connection to alternator term.61

2 = LED indicator for connection to stop lamp switch

Y

V

Continued on next coordinate

V

Continued on next coordinate

TEST STEP 4 ( TEST SPECIFICATIONS AND NOTES ON OPERATION )

Test step for program-switch positions 3 and 4 not applicable.

V

* Component/Function:

Operation of valve relay term.27

* Operation:

| | Position |
|---|---|
| Prog. switch | 5 |
| Button | – |

* Operation in vehicle:

Ignition on

* Test specification (reading)

LED 3 (top picture) lights up

N>

Trouble-shooting:

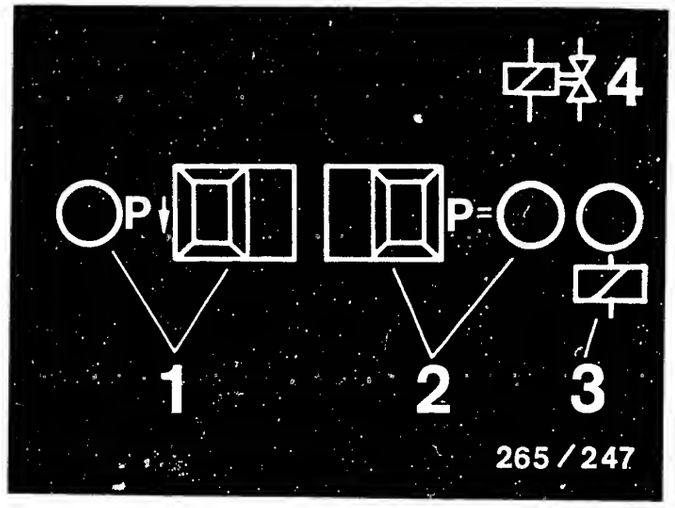
Switch off ignition!

No reading:

* Check following leads for open circuit and contact resistance.

From K1/term.27 to K9/term.2.
From K1/term.32 to K9/term.3.
From K9/term.3 to K3/term.5.
From K9/term.5 to B+ battery
From K9/term.1 to K19/term.5.

* Valve relay defective: replace.




Button and LED indication
1=Pressure-reduction function
2=Pressure-holding function
3=Indication of valve-relay operation
4=Symbol for solenoid valves

Y

Continued on next coordinate

V

Continued on next coordinate

D07 — <==>

D08 — <==>

TEST STEP 4 (CONTINUED) (TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS)

* Component/Function:

Check solenoid valves in hydraulic modulator for operation and mixing-up.

Pressure-holding function points 1 to 3 and pressure-reduction function points 4 to 5

Note:
Perform test separately for each wheel one after the other. Keep to sequence of operations

* Operation: Position
Prog. switch | 5 |

* Operation in vehicle and on tester:

Chock up vehicle. The wheel under test must be freely rotatable by hand.
Ignition on.
Set switch 1 (top picture) for wheel selection to the wheel under test.

1.(Bottom picture)
Button P = press continuously

* Test specification (bottom picture)
LED P = lights up

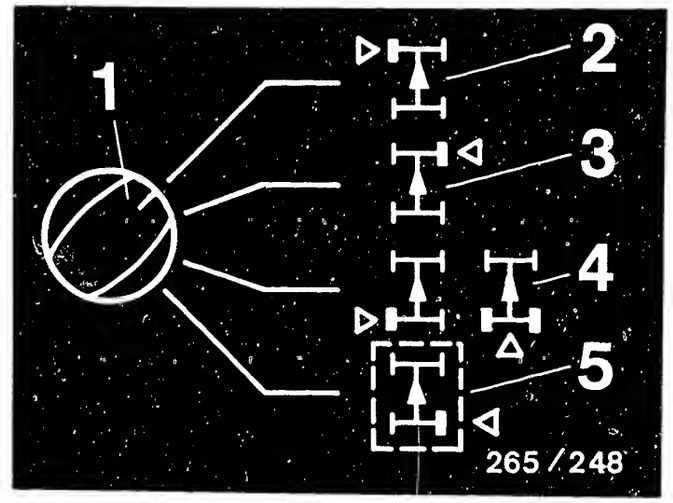
N>

Trouble-shooting (continued 1)

1. LED P (bottom picture) does not light up:

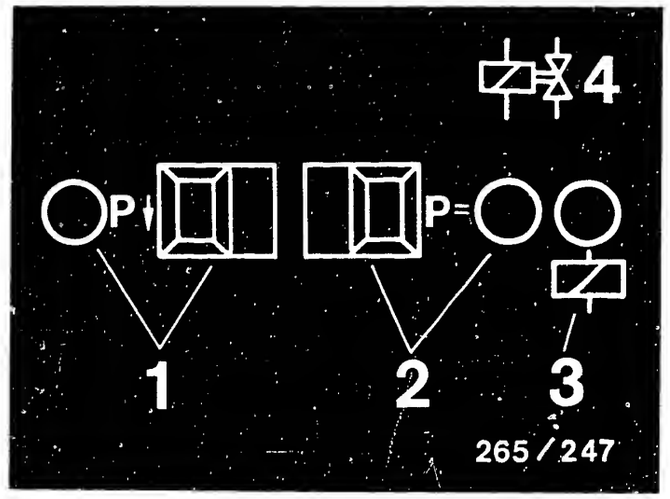
 * Battery insufficiently charged.
 * Repeat test with engine running.
 * Valve relay (normally-open contact) defective.
 * Ground terminals must be bare and securely connected
 * Check following leads for voltage drop and open circuit:

Ground lead from K1/term.10 to vehicle ground
Lead from vehicle ground to K19/term.3 and overvoltage-protection relay
Lead from multiple plug K1/term.34 to ground.
Positive lead from multiple plug to K1/term.1 to overvoltage-protection relay K19/term.5
Lead from valve relay K10/term.5 to B+.




1 = Wheel-selector switch
2 = Front left wheel
3 = Front right wheel
4 = Rear left wheel or rear axle
5 = Rear right wheel

Button and LED indication
1=Pressure-reduction function
2=Pressure-holding function
3=Indication of valve-relay operation
4=Symbol for solenoid valves




Continued on next coordinate

Continued on next coordinate

2.Press brake pedal constantly

<u>Test specification:</u>

Wheel rotatable by hand

3.Button P = release
(top picture)

<u>Test specification:</u> (top picture)

LED P = goes out, wheel
locks

4.Press button P arrow
(top picture)

<u>Test specification:</u> (top picture)

LED P arrow lights up,
wheel rotatable by hand.

5.Release button P arrow
(top picture)

<u>Test specification:</u> (top picture)

LED P arrow goes out,
wheel locks

6.Release brake pedal

N>

<u>Trouble-shooting (continued 2)</u>

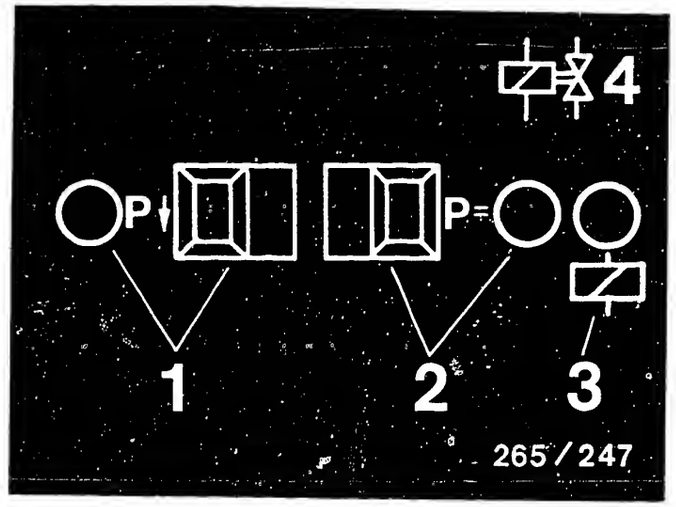
2. Locking of wheel/wheel
cannot be rotated

* Hydraulic brake lines
on hydraulic modulator
(bottom picture) mixed up.

* Solenoid valves correctly
connected electrically?

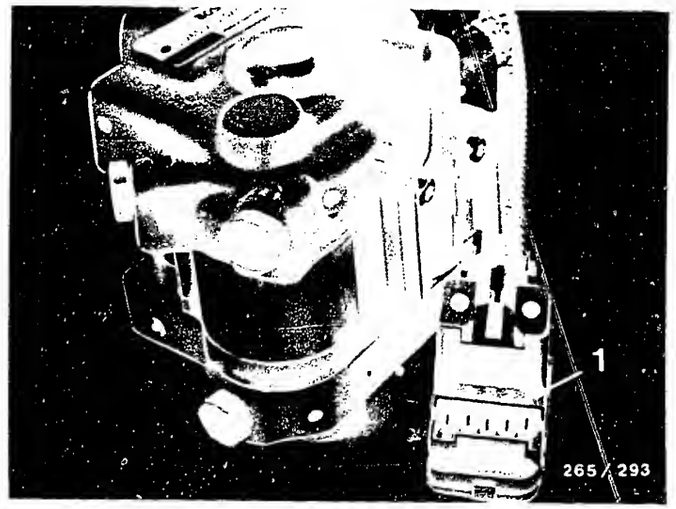
Front left wheel:
From plug K1/term.2 to
K3/term.2
Front right wheel:
From plug K1/term.35 to
K3/term.3
Rear axle:
From plug K1/term.18 to
K3/term.4

* Hydraulic modulator defective




Button and LED indication
1=Pressure-reduction function
2=Pressure-holding function
3=Indication of valve-relay
operation
4=Symbol for solenoid valves

1 = Plug K3




Continued on next coordinate

Removal of hydraulic modulator:

* For safety reasons, the hydraulic modulator must not be repaired, but may only be replaced as a complete unit.

  An exception to this is the valve relay. The relay may be replaced. The valve relay is no longer directly situated on the hydraulic modulator.

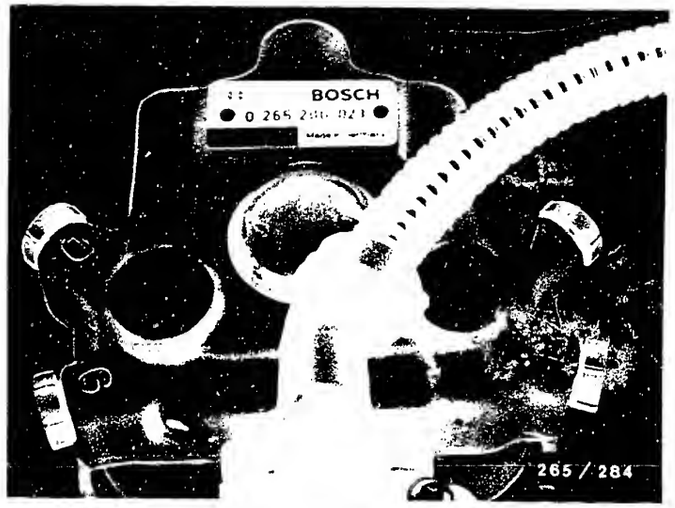
* Apart from the brake-line connections, no screws or bolts on the hydraulic modulator may be loosened.

  Under no circumstances may the covered central screw (center of hydraulic modulator) be loosened.

  After loosening, it is no longer possible to get the brake circuits leak-tight!
  D a n g e r !

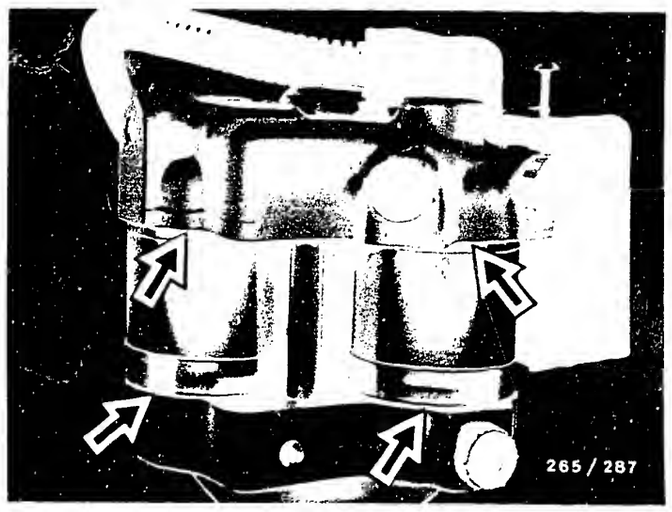
* Visually inspect hydraulic modulator and brake-line connections for leaks (see bottom picture).

If mineral oil is escaping, tighten the brake-line connections (screw on nut by hand and tighten moderately) or replace, or replace the hydraulic modulator.




Brake-line connections
G(VL) = Front left
D(VR) = Front right
A(HR) = Rear axle
R = Return

Joints, see arrows

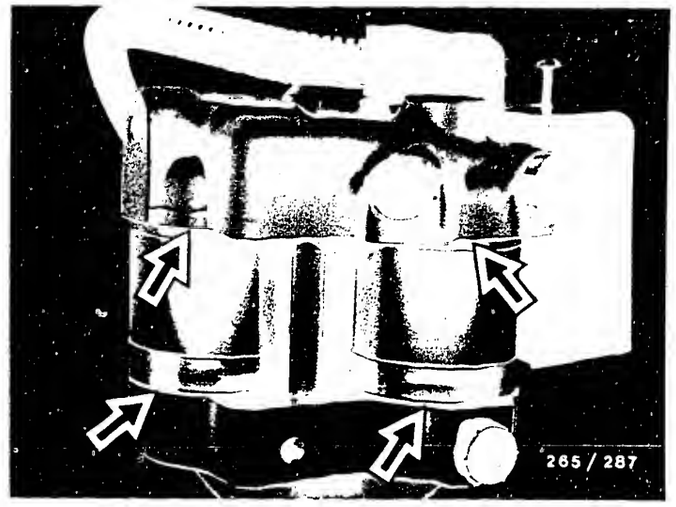


Pay particular attention to the joint identified by arrows (picture).

* When removing and installing the brake lines, make sure that the lines are marked according to the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. VL from hydraulic modualtor must be connected to the front left wheel-brake cylinder).
  CAUTION, when connecting, screw on nut by hand and tighten moderately.

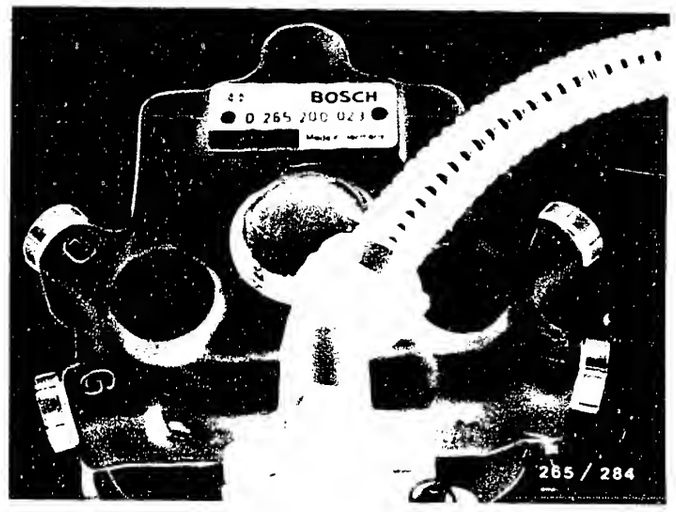
* Markings on hydraulic modulator:

G(VL)=Connection for front left brake line (wheel-brake cylinder)
D(VR)=Connection for front right brake line (wheel-brake cylinder)
A(HR)=Connection for rear-axle brake line (wheel-brake cylinder)
R =Return connection to mineral oil reservoir




Joints, see arrows

Brake-line connections
G(VL) = Front left
D(VR) = Front right
A(HR) = Rear axle
R = Return



* For loosening and tightening the brake lines, use only the specified double-head box wrench 8 x 10 mm.

* Mark brake lines and loosen from hydraulic modulator.

* Catch mineral oil.

* Seal brake lines and connections immediately with dummy plugs.

Installation

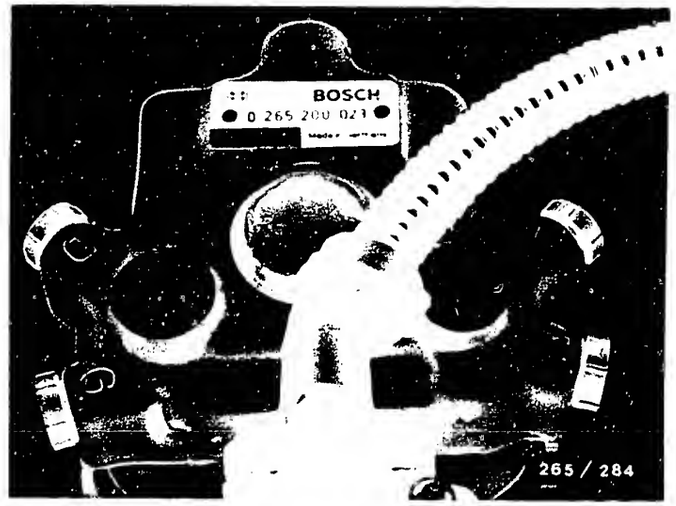
* Insert hydraulic modulator into the holder and fasten with the hexagon nuts.

* Connect brake lines, according to markings, to hydraulic modulator.

* Before connecting the brake lines, slide on new rubber sleeves with a clearance of approx. 2 mm from end of pipe. With sleeve moistened, center pipe in hole and check whether it goes all the way in. Screw on nut by hand and tighten moderately.

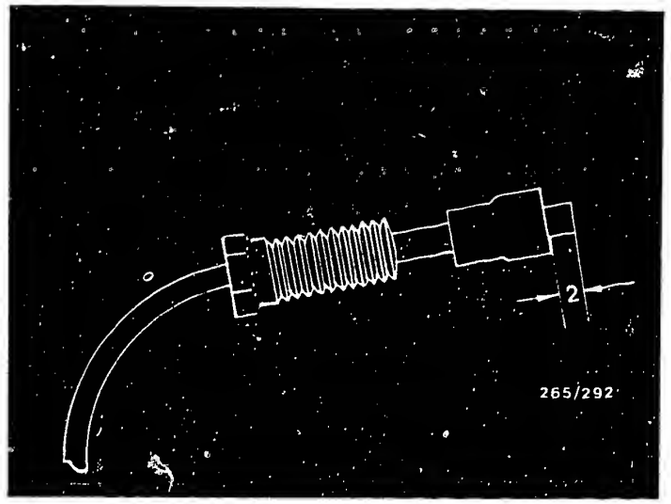
* Bleed brake system and check for leaks.

* Check ABS completely with LED tester.




Brake-line connections
G(VL) = Front left
D(VR) = Front right
A(HR) = Rear axle
R = Return

1 = Rubber sleeve
2 = Nut
3 = Brake line



TEST STEP 5 ( TEST SPECIFICATIONS AND NOTES ON OPERATION )

Component/Function:

Test wheel-speed sensors for proper functioning and any mix-ups.
Note:
Perform test consecutively for each individual wheel. Rear-axle test can be performed on left or right-hand wheel.

* Operation: Setting
  Prog. switch | 6 |

* Trigger function on vehicle and tester:

Jack up vehicle.
Ignition on
It must be possible to turn the wheel to be tested freely by hand. The wheel not tested must be held when testing the driven axle.

Set wheel selection switch to wheel to be tested (Fig., top)

Turn wheel by hand until LED 2 above instrument lights up without flickering. (speed approx. 1 revolution per second).

Then take instrument reading

N>

Trouble-shooting:

1. LED (bottom picture) does not light up.

* Wheel speed too low or too high.

* Drive speed of wheel too low or too high.

* Ring gear with incorrect number of teeth or ring gear missing or loose.

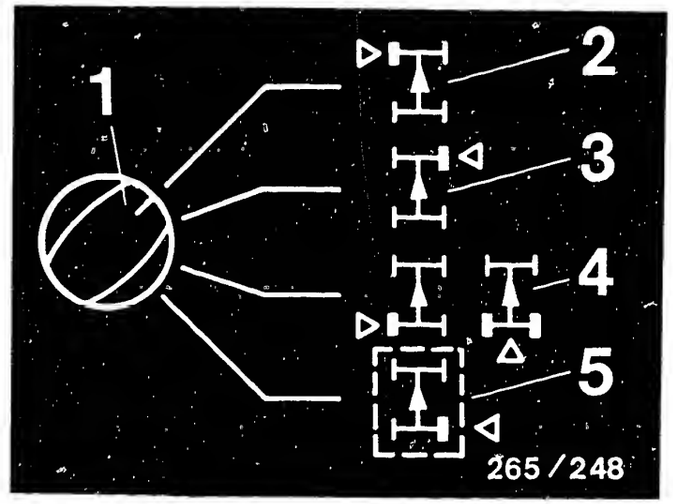
Number of teeth:
Front axle: 48
Rear axle: varying
number of teeth on propshaft, depending on transmission ratio.

2. Lighting-up of LED and instruments taking place in wrong switch position:

* Plug-in connections of wheel-speed sensors mixed up.

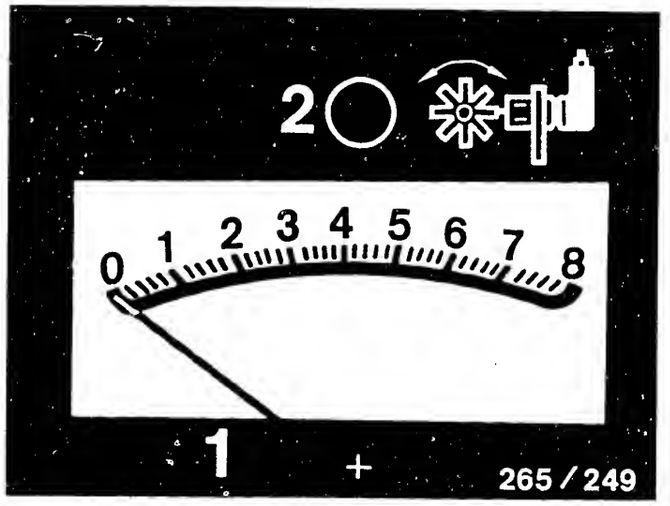
* Leads on plug K1 incorrectly connected.

  Check terminal assignment according to terminal diagram.




1 = Wheel-selector switch
2 = Front left wheel
3 = Front right wheel
4 = Rear left wheel
or rear axle
5 = Rear right wheel

1 = Instrument
2 = LED for wheel speed

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Continued on next coordinate

* Test specification (reading)

* Smallest reading greater than 1,6 scale divisions.
* Allowable fluctuation range max. 25 % of reading.

N>

Trouble-shooting (continued 1)

Ignition off.

3. No instrument reading:

* Check wheel-speed sensors for open circuit. Take apart plug-in connection and measure winding resistance with ohmmeter. Test specification: 0,6...1,6 k Ω

* Check following wheel-speed sensor leads for open circuit.

Front left wheel:
From plug K1/term.5 and term.4 to plug-in connection K 11.

Front right wheel:
From plug K1/term.11 and term.21 to plug-in connection K 13.

Rear left wheel:
From plug K1/term.8 and term.9 to plug-in connection K 15.

Rear right wheel:
From plug K1/term.24 and term.26 to plug-in connection K 17.

Finally, perform a road test. With engine running, warning lamp must go out. Drive at at least 30 km/h. Warning lamp must not come on again.

If no fault can be detected with the LED tester, check leads for loose contacts and rubbing, or replace controller.

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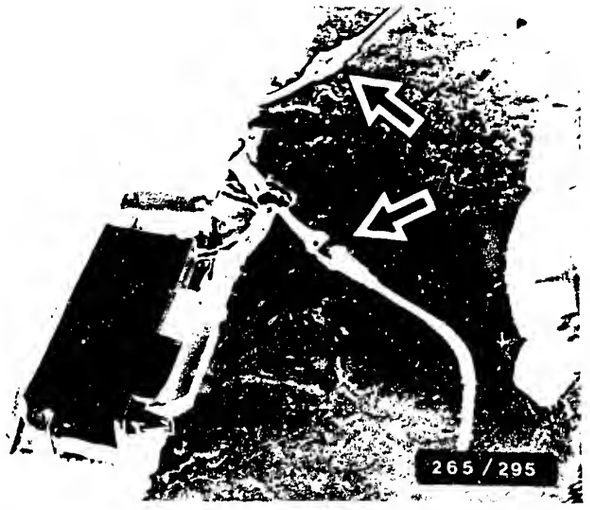
Continued on next coordinate


Arrows = Wheel-speed sensor plug-in connections front left (picture on left), front right (picture on right)

Arrows = Wheel-speed sensor plug-in connections, rear



Trouble-shooting (continued 2)

4. Instrument reading less than 1.6:

* Air gap between wheel-speed sensor and ring gear too big.

* Nominal air gap:
  Front wheels 0,8...1,2 mm
  Rear wheels 0,1...0,8 mm

* Ring gear defective or loose or with incorrect number of teeth.
  Front axle: 48 teeth
  Rear axle:
  varying number of teeth on propshaft, depending on transmission ratio.

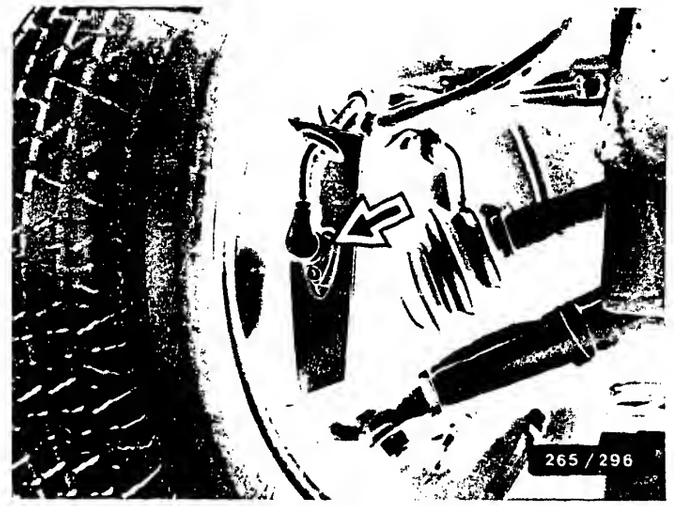
* Wheel-speed sensor defective: replace.

5. Fluctuation range too great:

* Wheel-bearing play too great

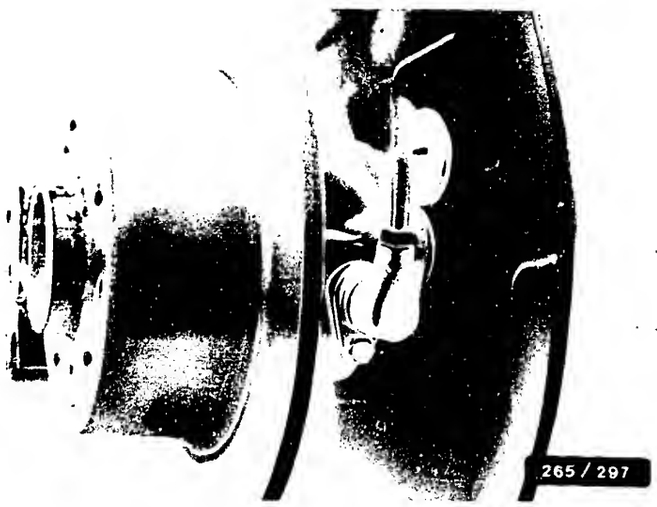
* Ring gear defective

* Ring gear out of round




Arrow = Front-axle wheel-speed sensor

Arrow = Rear-axle wheel-speed sensor

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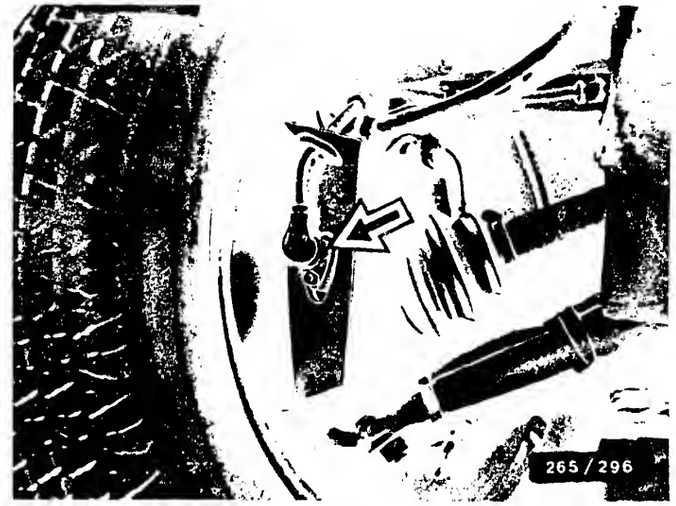
Removal of wheel-speed sensors:

* The plug-in connections of the front wheel-speed sensors are on the firewall at top right and left.
  The plug-in connections of the rear wheel-speed sensors are under the rear seat bench on left and right.

* Remove plug-in connection from holder and take apart.

* Loosen fastening screw for wheel-speed sensor and carefully remove wheel-speed sensor.
  Do not use force.




Arrow = Front-axle
wheel-speed sensor

Installation of wheel-speed sensors:

* Check O-ring for cracks and replace if necessary.

* Take new wheel-speed sensor out of protective sleeve only just before installing.

* Lightly grease wheel-speed sensor housing with lubricant Molykote Longterm 2.

* Make sure that there are no metallic foreign bodies on the permanent-magnet edge.

* Carefully press wheel-speed sensor into mounting hole as fas as it will go. Do not knock!

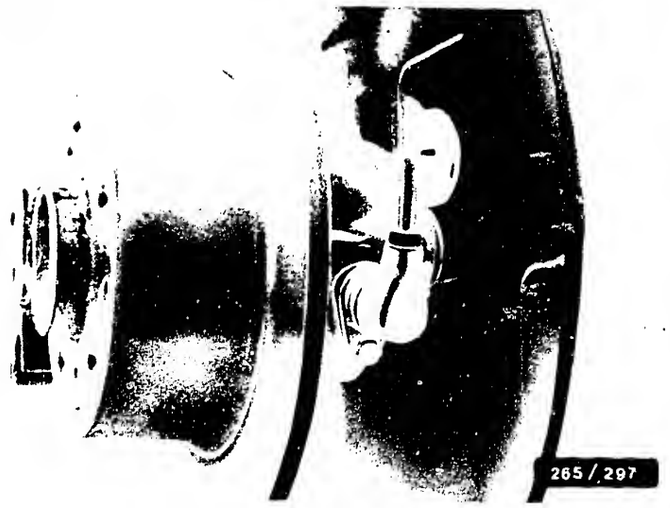
* Use new micro-encapsulated fastening screws (fillister-head screw M 6 x 10). Tighten fastening screw to at least 8 Nm

* Re-secure lead at the points provided.

* Connect wheel-speed sensor to ABS wiring harness and clip plug-in connection into holder.

* After repair, repeat test with LED tester.

Arrow = Rear-axle
wheel-speed sensor



T E C H N I C A L  B U L L E T I N

13....39
REPAIR PROHIBITION / VDT-I-265/102 En
MAXIMUM ALLOWABLE STORAGE TIME 1.1986
FOR ABS HYDRAULIC MODULATORS

Replaces edition of 7.1984

## 1. Repair prohibition

ABS for passenger vehicles is a safety system.
Unauthorized tampering with ABS components brings with it the danger of impairment of the proper functioning of the ABS system.

\# For reasons of safety, therefore, the
\# hydraulic modulator may under no circum-
\# stances be repaired, but instead must be
\# exchanged as a complete unit.

Only the engine and valve relays may be exchanged.
No other screws or plugs may be loosened or removed.

## 2. Maximum allowable storage time

The maximum allowable storage time for hydraulic modulators is 5 years from the date of manufacture (FD) specified on the product.



This requires that the following storage conditions be fulfilled:
- Hydraulic modulator filled with brake fluid (supplied in filled condition).
- Vertical/upright position (hood on top).
- Ambient temperature between -20°C and +50°C.
- Dry storage.

After 5 years storage time, all rubber and plastic parts must be replaced and the hydraulic modulator must be subjected to a functional test.

The replacement of rubber and plastic parts and the functional test can be carried out only at the place of manufacture. After testing, the hydraulic modulators are marked with |L| and a new date of manufacture (FD).

Service workshops in the Federal Republic of Germany should send the hydraulic modulators to:
Robert Bosch GmbH Abt. K1/VAK 2,
Robert-Bosch-Straße, 7141 Schwieberdingen.
Service workshops in other countries are requested to send the hydraulic modulators to:
Robert Bosch GmbH, KH/LAV 2 - Auspackraum,
z.W. an K1/VAK 2, Auf der Breit 4,
D-7500 Karlsruhe 41
West Germany.

The hydraulic modulators should be sent to us pre-paid.
Please refer to this Technical Bulletin on the enclosed delivery ticket.
A fee is charged for parts replacement and functional testing.

Responsible:
ROBERT BOSCH GMBH
Division KH
Technical After-Sales Service (KH/VKD 2)
Please address questions and comments concerning the contents to our authorized representative in your country.

For production reasons:
continued on the following coordinate.

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IMPRESSUM


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